Interim Final WTC Residential Confirmation Cleaning Study

Volume 1

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Note:
This interim final report is a working document that will be subject to further agency and third-party review. EPA intends to excerpt, and possibly expand, portions of this report for inclusion in manuscripts that will be submitted to scientific journals for review and consideration for publishing.

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Executive Summary

The United States Environmental Protection Agency (EPA) responded to the September 11, 2001 attack on the World Trade Center (WTC) in conjunction with the President's declaration of a national disaster. The Federal Emergency Management Agency (FEMA), the federal government office coordinating disaster response, issued mission assignments to EPA related to:

- cleaning dust and debris from the streets of lower Manhattan
- assessing the ambient environment through analysis of air and dust samples
- providing washing stations for decontamination of personnel and equipment involved in dust and debris removal operations, and
- disposing of hazardous materials found at the WTC response and recovery site.

Residents of lower Manhattan expressed concerns about the safety and reliability of cleaning methods utilized to remove dust and debris from residential unit interiors and building exteriors. Traditional FEMA support programs were available; however, residents requested additional assurance. To address concerns about the extent of indoor impact of dust and debris, as well as concerns regarding fire-related particle deposition, EPA Administrator Christine Todd Whitman formed an Interagency Indoor Air Task Force. The task force included representatives from the following agencies: EPA, FEMA, the New York City Department of Health and Mental Hygiene (NYCDOHMH), the New York City Department of Environmental Protection (NYCDEP), the New York City Office of Emergency Management, the New York City Mayor's Office of Environmental Coordination, the New York State Health Department, the New York State Department of Environmental Conservation, the Occupational Safety and Health Administration (OSHA), and the Agency for Toxic Substances and Disease Registry (ATSDR). The multidisciplinary, interagency group focused on issues of concern to residents and developed coordinated strategies to address the concerns.

In May 2002, EPA, FEMA and New York City (NYC) announced a voluntary cleanup program for residential units in lower Manhattan. This program would run parallel to and simultaneously with several other efforts, in order to reassure residents regarding the potential risks from exposure to residual WTC dust and debris, and to provide residents with the opportunity to have WTC residual material removed from their units as expeditiously as possible. Funded by FEMA through interagency agreements with EPA and NYC, these efforts include:

- identification of Contaminants of Potential Concern (COPC)
- a background study of the COPC in upper Manhattan (Background Study)
- inspection and cleaning of building exteriors in lower Manhattan
- Indoor Air Residential Assistance-WTC Dust Cleanup Program (WTC Dust Cleanup Program)
- cleaning of unoccupied, uncleaned residential buildings, and
- study of cleaning techniques in an unoccupied building adjacent to the WTC site that was directly impacted by the WTC collapse (WTC Residential Confirmation Cleaning Study).

This report presents the results of the WTC Residential Confirmation Cleaning Study (study) conducted by EPA.

Background

Following the attack on the World Trade Center, residential living spaces in the immediate vicinity of ground zero were impacted by dust and debris. Samples of dust and debris collected by EPA from the streets of lower Manhattan contained asbestos at levels greater than one percent of sample mass in approximately 35 percent of the 160 samples taken between September 11, 2001 and October 10, 2001. A study of residential unit interiors proximal to the WTC site was funded by FEMA, and implemented by ATSDR and NYCDOHMH with EPA support. This study concluded that although air sampling indicated that asbestos in air benchmarks had not been exceeded, residual material in the dust was attributable to the WTC attack and collapse. Preliminary results of this study were provided early in 2002. Final results were issued in September 2002.[1]

Shortly after the disaster, NYCDOHMH, EPA and others provided the residents of lower Manhattan with recommendations on cleaning methods through the media, fact sheets and community meetings. These recommendations were based on previously established cleaning procedures that were proven to be effective in removing layered particulate matter and debris with minimal dust generation.

Objectives

In an effort to provide additional information to the public on cleaning methods that may be effective in reducing contaminants from dust generated by the WTC collapse and recovery efforts, EPA, in concert with FEMA and NYC, commenced a study of a building on Liberty Street, just south of the WTC site, that had been heavily impacted by the collapse of the twin towers. The purpose of the study was to confirm the adequacy of various cleaning and vacuuming methods used by residents and professional cleaning companies, in the aftermath of the attack, to clean dust and debris from residential living areas.

Project Implementation

EPA and its contractors commenced the WTC Residential Confirmation Cleaning Study on June 14, 2002. The study addressed cleaning of a complex mixture of contaminants, including construction debris and fire-related compounds. EPA was unaware of a precedent for an indoor environmental cleanup with such a diverse set of parameters; however, time pressures did not allow for conducting extensive research on potential cleaning techniques in a controlled setting. The real-time need to determine the effectiveness of the cleaning methods being used by residents, and being employed in the WTC Dust Cleanup Program, drove the decision to field test the effectiveness of the standard dust removal methods in a heavily impacted, unoccupied building.

Eleven cleaning methods were selected for testing and assigned to residential units within the building according to the levels of observed dust. An attempt was made to test each method in units with both significant and minimal levels of dust.

Multiple endpoints were used in the study to ensure that the complexity of the dust was comprehensively considered. Analytical results were compared to health-based benchmarks for pre-selected COPC to determine if the cleaning was successful in achieving these values. The

[1] New York City Department of Health and Mental Hygiene/Agency for Toxic Substances and Disease Registry (NYCDOHMH). (2002). *Final Report of the Public Health Investigation to Assess Potential Exposures to Airborne and Settled Dust in Residential Areas of Lower Manhattan.*

COPC included: asbestos, lead, dioxin, polycyclic aromatic hydrocarbons (PAH), fibrous glass and crystalline silica (alpha-quartz, cristobalite, tridymite.)

The study used a combination of data sets to determine the extent of contamination, the effectiveness of cleaning methods, and the differences of sampling and analytical methods.

A summary of the significant conclusions of the study are provided below. These include observations about the extent of WTC-related contamination within the building and the effectiveness of the cleaning methods tested in the study.

Conclusions Regarding Contamination of the Building:

- The study found that the observation of WTC dust is an indicator that WTC contaminants may be present and that the amount of WTC dust correlates with the level of contamination.

- The study found that concentrations of some contaminants in the WTC dust were elevated above health-based benchmarks.

Conclusions Regarding Cleaning Effectiveness:

- The study demonstrated that the use of a standard cleaning method of vacuuming and wet wiping significantly reduced levels of WTC-related contamination with each cleaning event and was successful in reducing concentrations to levels below health-based benchmarks.

- The study found that one to three cleanings were necessary to reduce contamination levels to below health-based benchmarks, and the number of cleanings required generally correlated with the levels of contamination initially identified in the units.

- The study found that standard Heating, Ventilation and Air Conditioning (HVAC) cleaning methods reduced the concentrations of WTC contaminants in HVAC systems.

- The study found that conducting asbestos air sampling was a conservative method for determining if additional cleaning was needed.

The study successfully demonstrated that standard cleaning practices are effective in removing the complex mixture of WTC dust, thereby reducing individual exposure to WTC-related contaminants. Therefore, EPA's recommendation continues to be that individuals concerned about the presence of WTC dust use HEPA vacuums and wet wiping to remove the dust from their dwellings. Depending on the amount of dust deposited, repeated cleanings may be necessary.

1. Introduction

In an effort to provide information to the public on cleaning methods that would be effective in removing dust and contaminants generated by the WTC collapse and recovery efforts, EPA, in concert with FEMA and NYC, began a study of a building that had been impacted. The building was located on Liberty Street, just south of the WTC site. On June 14, 2002, EPA and its contractors commenced the WTC Residential Confirmation Cleaning Study to confirm the adequacy of various cleaning and vacuuming methods that may have been used by the residents of lower Manhattan and professional cleaning companies to clean dust and debris from residential living areas.

1.1 Background/Objectives

Shortly after the collapse of the WTC, NYCDOHMH, EPA and others provided the residents of lower Manhattan with recommendations on cleaning methods through the media, fact sheets and community meetings. These recommendations were based on previously established cleaning procedures that were proven to be effective in removing layered particulate matter and debris, with minimal dust generation. The WTC Residential Confirmation Cleaning Study was conducted to provide the residents with additional information. The effectiveness of the cleaning methods tested in the study was evaluated through the collection and analysis of pre-cleanup and post-cleanup samples, and comparison of the resulting analytical data to health-based screening levels for the COPC. Table 1.0 presents the primary clearance criteria used to determine cleaning effectiveness.

The study's COPC included: asbestos in air by phase contrast microscopy equivalent (PCMe) [2], lead in air and settled dust, dioxin in air and settled dust, PAH in air and settled dust, fibrous glass and man made vitreous fibers (MMVF) in air, and alpha-quartz in air. More detail on the selection of these compounds is included in Section 1.2.

In addition to evaluating data for the COPC in their respective media identified above, data was also evaluated for COPC that were analyzed using alternate analytical methods [e.g., asbestos in air using PCM and transmission electron microscopy (TEM) Asbestos Hazard Emergency Response Act (AHERA), COPC in other media (e.g., asbestos, MMVF, and alpha-quartz in settled dust), compounds that were included as part of the crystalline silica analytical analysis (e.g., cristobalite, tridymite, calcite, and gypsum in air and wipe samples]. The results from these additional analyses were primarily used to evaluate the cleaning methods as there were no health-based benchmarks for comparison. The exception would be the asbestos in air PCM and TEM AHERA results, which in addition to being used to evaluate the cleaning methods, were also compared to their respective regulatory criteria.[3] These regulatory criteria are referred to as

[2]The asbestos air samples were collected according to NIOSH 7400 (PCM). The sample filters were analyzed using a modified AHERA method. Although the total TEM (AHERA) fiber count was recorded, a separate PCM-equivalent (PCMe) count was recorded by modifying the AHERA method to count only fibers greater than 5 μm (micrometer). It is this modified-AHERA PCMe fiber count that was the basis of the asbestos test results and clearance criterion.

[3]The regulatory clearance criterion for TEM AHERA was 70 S/cm^2, converted to 0.022 S/cc, based on a volume of 1200 cc. The regulatory criterion for PCM AHERA was 0.01 f/cc based on a volume of 1200 cc.

secondary numeric criteria. Cleaning continued in the residential units and commercial spaces until primary clearance criteria were achieved. Some areas required three cleaning events.

This report provides information on the type of cleaning and sampling methods that were used, the results of the analytical analyses performed, and the conclusions that were made based on the information collected.

1.2 Identification of Contaminants of Potential Concern (COPC)

Under the auspices of the Interagency Indoor Air Task Force working group, a committee was formed to identify contaminants of potential concern (COPC) and associated health-based clearance criteria for the lower Manhattan clean-up program. Among other purposes, this initiative was intended to inform the selection of contaminants to monitor in the WTC Residential Confirmation Cleaning Study and Background Study and to provide a measure of cleaning effectiveness by establishing health-based clean-up goals for indoor air and settled dust. A draft of the COPC/Benchmarks Report prepared by EPA was peer reviewed on October 21-22, 2002. The final report is currently being completed. As such, the COPC identified for inclusion in the study reflect those contaminants cited in the peer review draft of the COPC/Benchmarks Report.[4]

The development of the COPC report began with an assessment of the indoor environment by reviewing historical information on hazardous substances that have been associated with building fires and collapses. Many compounds, including combustion byproducts such as dioxins and PAH were identified, along with building materials such as asbestos and fibrous glass. Ambient air, indoor air, and indoor/outdoor bulk dust monitoring data were also reviewed. Data sources included EPA's ambient air and bulk dust/debris monitoring program (www.epa.gov/wtc), OSHA's air/dust monitoring data, and the NYCDOHMH/ATSDR indoor air pilot program. A concerted effort was also made to identify and review additional sources of WTC-related data from other governmental agencies (e.g., U.S. Geological Survey, NYC Department of Education) academic institutions, environmental organizations, and the private sector.

A semi-quantitative screening process was performed on the collected sampling data referenced above. Based on frequency of detection, concentration, and inherent toxicity, contaminants that exceeded health-based screening levels for ambient air were identified. Dioxin and PAH were added to the COPC list by this process. In addition, building constituents with carcinogenic effects (asbestos) or irritant effects (fibrous glass, alpha-quartz) that were consistently and significantly found in bulk debris and indoor dust samples were identified as COPC.[5] Finally, lead was included based on a comparison of sampling data with existing regulatory standards. Collectively, the resulting group of contaminants (asbestos, lead, dioxin, PAH, fibrous glass and alpha-quartz) are called "contaminants of potential concern" or COPC in this report.

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[4]U.S. Environmental Protection Agency. (September, 2002). *World Trade Center Indoor Air Assessment: Selecting Contaminants of Concern and Setting Health-Based Benchmarks*. A draft report. Peer review has been completed; final publication pending. Customarily referred to as the COPC/Benchmarks Report.

[5]NYCDOHMH, 2002.

1.3 Development of Clearance Criteria for Lead

At the time the study was initiated, COPC benchmarks were established for all contaminants except lead. Initially, the clearance criterion used for lead was 0.1 $\mu g/m^3$, which was based on an estimated national background concentration. Risk-based clearance criteria for lead in indoor air provide a means to evaluate the effectiveness of the WTC residential cleaning program. Information on background concentrations of lead in indoor air also informs attainment of cleanup objectives. Background information has been obtained from historical information on ambient air lead concentrations in urban environments, and will be further refined with data from a site-specific background study being conducted as part of the WTC Dust Cleanup Program.

Table 1.0
Primary Clearance Criteria Used to Determine Reoccupancy[6]

Compound	*Air*	*Settled Dust*
Asbestos	0.0009 S/cc	N/A
Polycyclic Aromatic Hydrocarbons (PAH)	0.2 $\mu g/m^3$	300 $\mu g/m^2$
Dioxin/Furan	0.001 ng/m^3	4 ng/m^2
Lead	1 $\mu g/m^3$	25 $\mu g/ft^2$ (micro vacuum comparison value 25 $\mu g/ft^2$)
Fibrous Glass (Man-made Vitreous Fibers)	10 S/L	N/A
Alpha-quartz (0.001 mg/m^3 - 0.004 mg/m^3 based on analytical methods)	0.004 mg/m^3	N/A

EPA's risk assessment methodology for lead has been advanced through use of a biokinetic model[7] that incorporates a biomarker of exposure/effect (blood lead) and multimedia exposure modeling. Through use of this model EPA identifies a goal of reducing environmental lead exposure so that 95 percent of childhood blood lead levels are below 10 µg/dl. This goal is accomplished when the airborne lead concentration is set at 1 $\mu g/m^3$, and input values for all other sources of environmental lead exposure (e.g., water, soil, dust, diet) are set at background concentrations.

[6] U.S. Environmental Protection Agency. (September, 2002). *World Trade Center Indoor Air Assessment: Selecting Contaminants of Concern and Setting Health-Based Benchmarks*. Values have been excerpted from this draft report.

[7] U.S. Environmental Protection Agency. (February, 1994). *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children.* (OSWER EPA/540/R/93/081).

1.4 The Project Team

The study was designed, implemented and managed by EPA staff with the assistance of EPA's contractors: WRS Infrastructure and Environment, Inc. (WRS) and Weston Solutions, Inc. (Weston).

EPA's project team consisted of three individuals from the Region 2 Removal Action Branch detailed to the region's New York City Response and Recovery Operations (NYCRRO). The individuals included a Section Chief and two On-Scene Coordinators (OSCs) who were responsible for overall management and oversight of the contractors assigned to the project. All communication regarding site work activities, work scheduling, difficulties encountered, deviations from the work plan or sampling plan, and project progress were addressed by the OSCs on a daily basis.

The WRS project team consisted of fourteen individuals: the response manager, the site health and safety officer, the project coordinator/field accountant, the foreman, and seven laborers who were supported by the program manager, the alternate program/contracts manager, and the corporate health and safety manager. WRS provided equipment and services associated with the cleaning operations.

The Weston project team consisted of eight individuals: the project manager, two sample technicians, two technical writers, one technical artist and two data validators who were supported by the program manager and assistant program manager. Weston provided deliverables and services associated with the sampling operations.

1.5 Cleaning Methods

The Residential Confirmation Cleaning Study called for the testing of eleven cleaning methods. These ranged from basic vacuuming with standard household equipment, to wet vacuuming of carpets, to the use of commercial quality vacuums equipped with High Efficiency Particulate Air (HEPA) filters, to wet wiping with water only or soap and water, to cleaning of HVAC systems.

The study focused primarily on cleaning methods used to clean residential living areas. However, two commercial units were included in the study. Cleaning of the commercial units was necessary to avoid the redistribution of dust from uncleaned areas to clean areas, because the commercial units were located on the same floor of the building as the apartments. These units also provided an opportunity to gain experience relative to the cleaning of heating, ventilation, and air conditioning units that may have been impacted by the WTC collapse. Cleaning of the commercial units was a condition of the access agreement agreed to with the building owner.

At the time of the WTC attack, these two commercial units had been used as a Chiropractor's Office and a retail Mattress Store. To complete the remainder of the building, three additional commercial units, including two restaurants (Lemongrass Grill and The Food Exchange) and a Barber Shop were cleaned.

EPA applied up to two cleaning methods in each of thirteen residential units, and up to five cleaning methods in each of two commercial units. The eleven cleaning methods tested are presented below:

1. Residential quality upright vacuums and shop vacuums.
2. Residential quality upright vacuums and shop vacuums with the addition of an Air Filtration Device (AFD).
3. HEPA-filtered upright and shop vacuums.
4. HEPA-filtered upright and shop vacuums with the addition of an AFD.
5. Industrial quality HEPA-filtered vacuums.
6. Industrial quality HEPA-filtered vacuums with the addition of an AFD. **(This cleaning method was used in both residential and commercial units.)**
7. Wet wiping of all horizontal and/or vertical surfaces with soap and water.
8. Carpet cleaning.
9. Standard cleaning procedures used by professional duct cleaning companies for the cleaning of air conditioning (A/C) systems, ducts and related equipment.
10. Use of water only for wet wipe of horizontal and/or vertical surfaces.
11. Scope A cleaning procedures developed by EPA and New York City for the cleaning of units in lower Manhattan.

Determination of which cleaning method would be studied in each rental unit was based on the apparent level of impact that unit had endured as a result of the WTC collapse. EPA developed a set of four tests to evaluate cleaning methods in the rental units. The tests were assigned based upon readily observable impact by WTC dust, and prescribed six of the eleven cleaning methods to be used to respond to each level of impact. Up to five different cleaning tests were tested in each residential and commercial unit. Factors related to level of impact included directional exposure to ground zero and location of the unit in the building.

At project commencement, a visual assessment of the level of impact each rental unit had sustained was performed. This assessment was utilized to assign each rental unit to an applicable cleaning test. The assignment process was modified to ensure that each of the cleaning methods was applied (tested) in units that had experienced both low and high levels of observable impact.

The effectiveness of the cleaning methods was evaluated through the collection and analysis of pre-cleanup and post-cleanup samples, and through comparison of the resulting analytical data to the COPC, to determine if the cleaning method achieved health-based screening levels. The COPC evaluated in this study were: asbestos in air by PCMe, lead in air and settled dust, dioxin in air and settled dust, PAH in air and settled dust, fibrous glass (MMVF) in air, and alpha-quartz in air.

Data was also evaluated from other compounds that do not have health-based benchmarks established in EPA's COPC/Benchmark Report. These included asbestos in air by PCM and TEM AHERA, asbestos in settled dust, calcite in air and settled dust, gypsum in air and settled dust, cristobalite in air and settled dust, tridymite in air and settled dust, fibrous glass (MMVF) in settled dust by wipe sampling, alpha-quartz in settled dust by wipe sampling and total settled dust. After the initial cleaning of each unit, the OSC reviewed the established cleanup criteria, reviewed the analytical results, and provided direction as to which units required additional cleaning. In the event that it was determined that a unit did not achieve the primary clearance criteria, it was

cleaned a second time using the same method as the original test. The unit was then tested again for the COPC that did not meet the health-based benchmark during the first test. If the unit failed to achieve the cleanup criteria again, it was cleaned with the strongest equipment (commercial quality vacuum with HEPA filter and an AFD). Midway through the project, the clearance criterion for lead was revised to use a health-based benchmark rather than a background level benchmark. This eliminated the need for re-cleaning some units, because the revised criterion indicated lead levels were lower than the newly established benchmark. For the most part, the health-based benchmarks were achieved after the first or second cleaning was completed. However, two units required three cleanings.

Air samples were collected to monitor for employee exposure during cleaning operations. Results are presented in Attachment A, *Personal Monitoring Data.*

1.6 The Work Plan

Specific procedures that were followed to perform the study, and a summary of all changes that were made to the work plan during the course of the study, are presented in Attachment B, *The Work Plan and Changes to the Work Plan*.

1.7 Project Documentation

At project commencement, digital photographs of all building interiors and building contents were taken. An inventory of personal belongings was developed. Photo documentation of the condition of each unit was compiled prior to each activity in the unit. Contents, conditions and specific areas of interest were digitally recorded. Photo documentation continued during initial sampling tasks. A record of equipment, materials, procedures and areas sampled was also maintained. Crews working in each unit were photographed. Procedures, equipment, and conditions were recorded during cleaning operations. All photographs were digitally recorded and are available upon request from EPA.

2. Cleaning Activities

2.1 Building Logistics

The study was conducted in a building supporting both residential and commercial use at the southern edge of ground zero. Located at 110 Liberty Street, New York, NY, the building is situated between Liberty and Cedar Streets. Accessible from both Liberty and Cedar Streets, it has a co-address of 113-117 Cedar Street. The location of the building in relation to ground zero is presented in Attachment C, *Site Map*. The building contains thirteen residential apartments and five commercial units, as well as common areas. It is five stories high. Prior to the WTC attack, all of the residential units were occupied, and the commercial units accommodated operating businesses. The configuration of the building interior is presented in Attachment D, *Floor Plans*.

The Residential Apartments

The thirteen residential apartments range in size from 655 square feet to 1,335 square feet. The dwellings have an open floor plan design. Each provides a kitchen, a bathroom, and bedrooms, as well as a utility closet containing a water heater and a furnace.

The Commercial Units

The five commercial units range in size from 716 square feet to 2,451 square feet. Two of these, both located on the second floor, were cleaned as part of the study:

- Chiropractor's Office
- Mattress Store

The remaining three commercial units were not part of the study, but were cleaned at the conclusion of the study, to complete the remainder of the building and to satisfy a condition of access for EPA to conduct the study:

- Lemongrass Grill
- The Food Exchange
- Barber Shop

The Lemongrass Grill has dining room facilities located on the first floor. Its preparation facilities are located in the basement. The Food Exchange is located on the first floor. Its preparation facilities are also in the basement. The Barber Shop is entirely situated in the basement.

The Common Areas

Common areas include an elevator, stairwells and hallways. There is a trash compactor room and a utility room on floors two through five. A common laundry room is located on the second floor. The basement contains an elevator shaft and motor room, a trash compactor room, a fire equipment room, the Barber Shop and preparation and storage areas for The Food Exchange and Lemongrass Grill.

Air Conditioning Systems

All of the residential and commercial units included in the study were heated by hot water

baseboard systems. In most cases, window-mounted air conditioners were in place to cool the residential units. Types of air conditioning systems present in the building are identified in Table 2.0.

Table 2.0
Air Conditioning Systems by Unit

Unit	*System*
Residential Apartments 5A, 5C, 5D	Ductless A/C unit, with remote condenser/compressor unit
Residential Apartments 2A, 2B, 3B, 3C, 3D, 4A, 4B, 4C, 4D	Window/wall mounted units
Baldwin Realty Company (3A)	Ductless A/C with remote condenser/compressor unit
Chiropractor's Office	Air handling unit with remote condenser/compressor unit (Atrium)
Mattress Store	Air handling unit with remote condenser/compressor unit (Atrium)
Lemongrass Grill	HVAC self contained system, makeup air system with hood, 2 ductless air systems with remote compressor/condenser units (Atrium)
The Food Exchange	Two air handling units with remote cooling tower (Atrium)
Barber Shop	Ductless A/C unit with remote condenser/compressor unit

Building Condition
Both Cedar Street and Liberty Street were closed to traffic after the WTC attack. Tenants were not permitted to enter the building. EPA, other governmental officials, and the building owner had been the only individuals authorized to enter the building since September 11, 2001. Presently, the residential spaces of the building are being re-occupied. The NYC Building Department inspected the building for structural integrity prior to EPA mobilization to the site.

The building interior had been professionally cleaned by the building owner, Liberty Street Associates, LLC, shortly after the collapse of the WTC. Those cleaning activities focused on the removal of gross dust and debris. Floors, walls and ceilings were cleaned using HEPA vacuums, AFDs and wet wiping using soap and water. Personal items, such as furniture, clothing, electronics and kitchenware were not cleaned. The cleaning began on October 29, 2001 and was completed on November 11, 2001. The cleaning performed during this period was limited to the residential units, the common areas, the basement, the roof, and the Baldwin Realty Company

office. None of the other commercial spaces had been cleaned.

Although the cleaning discussed above took place prior to implementation of the study, there had been significant redeposition of dust that had become airborne during the removal of the WTC-related debris. At project assignment, the Chiropractor's Office and the Mattress Store were covered with inches of dust. The New York City Fire Department vacuumed dust from these units just prior to commencement of the study, as part of the recovery operation. Prior to cleaning, each unit was inspected and photographed to document its condition and contents. Bulk dust samples were collected.

At the onset of the project, the condition of the units varied. Some units evidenced significant impact, while other units evidenced minimal impact by dust and debris related to the WTC incident. The units facing Liberty Street contained a larger quantity of dust than those facing Cedar Street. All of the residential and commercial units contained dust generated and redeposited by the work effort at ground zero. The amount of dust appeared to be dependent on the location of the unit with respect to its orientation to ground zero, and the degree of damage it had sustained during and after the collapse.

During the initial cleaning, the doors and broken windows facing Liberty Street had been secured with plywood. However, they were not secured in a manner that would sufficiently seal them to prevent the entry of dust being generated during debris removal operations. Likewise, skylights located on the top floors of the building had been damaged and offered a pathway for dust to migrate into the building. These conditions existed during most of the WTC recovery effort.

Building Contents

All of the residential rental units contained personal possessions. Some units were fully furnished, containing numerous personal possessions. Others contained few furnishings and/or personal possessions. The commercial units contained property customarily found in those types of business establishments. For example, the Mattress Store contained a display of twenty-five box springs and mattresses. The restaurants contained dining room tables, chairs, food preparation equipment, and food.

Prior to commencement of cleaning operations, each tenant was contacted for the purpose of scheduling an appointment to determine the tenant's wishes relative to disposition of their belongings. At the appointment, residents were suited with hooded, powered air-purifying respirators (PAPR), which pull ambient air through a filter. The residents were advised of the applicable aspects of the Health and Safety Plan, including dust and respiratory hazards. (The Health and Safety Plan is discussed in Section 2.2 below.) The residents then accompanied EPA into the apartments to review contents and to discuss the planned disposition of personal property.

Residents were advised that retention of porous items was not recommended due to the difficulties associated with cleaning and testing. Residents were given the option of having their possessions: cleaned on the spot so the resident could immediately take possession, cleaned later and left in the apartment, or disposed of by EPA.

2.2 Personal Air Sampling, Personal Protective Equipment and Safety Risks

Personal air sampling was conducted for the workers that were participating in cleaning activities. Air sampling conformed to the site specific Air Surveillance Plan which is included in Section 8.0 of the Site Health and Safety Plan. The Site Health and Safety Officer conducted daily air sampling of employee exposure to three contaminants: asbestos, alpha-quartz and lead. On only one occasion during the study was the permissible level for alpha-quartz exceeded. Comprehensive information relative to health and safety is provided in Attachment E, *Health and Safety Plan, Changes and Issues*.

Personal Protective Equipment
The study was conducted using the following levels of protection:

- Level D+: This level of protection requires employees to wear safety glasses, disposable coveralls (Tyvek®), disposable head coverings, disposable undergarments, disposable gloves, disposable boot covers, steel-toed boots, and hearing protection (if applicable).

- Level C: This level of protection requires employees to supplement the above with an air purifying respirator (half face or full face PAPR) equipped with P100 cartridges.

Safety Risks
At project onset, all units and common areas were inspected to assess building condition and to identify safety risks such as: gas, oil, and water leaks; perishable foods; rodent/insect infestations; damaged floors, walls, stairways, and elevators. All safety risks identified were eliminated prior to commencement of cleaning activities. The safety risks identified included electrical concerns, necessary building repairs, building access concerns, and rodent infestation. Additional details relative to safety risks are provided in Attachment E, *Health and Safety Plan, Changes and Issues.*

2.3 Equipment

EPA selected equipment similar or identical to the equipment observed in use by residents of lower Manhattan after the attack on the WTC, and tested use of this equipment in performing the cleaning of residential apartments at the project site. A commercially produced vacuum manufactured by Nilfisk™ Advance Vacuum Systems was selected to provide industrial strength vacuuming technology, because many management companies who cleaned residential and commercial spaces in lower Manhattan purchased Nilfisk™ equipment. Furthermore, confidence in the strength of the equipment had been evidenced in that it had been used by companies to clean federal buildings of anthrax prior to the study.

In the aftermath of the WTC attack, vacuums were made available to the general public by the American Red Cross, and a vacuum reimbursement program was established by New York State in conjunction with FEMA. The vacuums made available to the public included vacuums with HEPA-filtration made by Eureka®, Hoover® and Mastercraft®. Shop vacuums produced under the Ridgid® brand and Craftsman® brand were also observed in use by residents of lower Manhattan in the wake of the attack. High efficiency particulate air (HEPA) filters are capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in

diameter. The study tested cleaning using vacuums with and without HEPA filtration.

An Air Filtration Device (AFD) is a local exhaust system with HEPA filtration that is capable of creating and maintaining a negative pressure differential between the outside and the inside of the work area. The AFD functions as a stand-alone piece of equipment in a room. During the study, the AFD was used as an air-polishing device, to capture dust particles that became airborne as a result of disturbances caused by the cleaning activities. The study tested cleaning with and without use of AFDs.

Shop vacuums are easy to maneuver and are designed to pick up dust, shavings and debris. Upright vacuums are designed for use on horizontal surfaces such as floors. For purposes of the study:

- The Eureka® and Hoover® upright vacuums were purchased both as devices with HEPA filtration and as devices with standard bag filtration.
- The Ridgid® and Craftsman® shop vacuums were interchangeable. (Both can be changed from a standard cartridge filter to a HEPA-rated cartridge.)

Wet vacuums are designed to clean horizontal porous surfaces with soap and water (shampoo). The wet vacuum used in the study was an upright model, providing a suction head lift of 103 inches of water. Suction head is the measure of the suction capacity of a wet vacuum pump. In this case the wet vacuum pump is capable of lifting water 103 inches.

Table 3.0 identifies equipment manufacturer and model used in the study. However, there was no intent of the study to compare manufacturers or the relationships between any particular devices. The objective of the cleanup was to confirm the effectiveness of cleaning of individual spaces using different equipment.

Table 3.0
Equipment Manufacturer and Model

Make	***Model***
Nilfisk™	CFM127
Hoover® (HEPA)	U6459-900
Hoover®	U5046-930
Craftsman®	113.170250
Eureka® (HEPA)	S4170
Eureka®	7618
Ridgid®	WD17351
Carpet Express®	C4 (wet vac)
ACSI® (AFD)	400/600
ForceAir 2,000® EC (AFD)	1000/2000

Field Observations of Equipment Used

Upright vacuums are designed for use on horizontal surfaces such as floors. These use rotating devices to collect dust, and do not provide direct suction force. Brush attachments were used on the horizontal surfaces that could be reached. The hose attachments were limited according to their length and hose type. Plastic hose was not as resilient as rubber or cloth-covered hose. Attachments such as the crevice tools were used with ease because of their small profile. These were made of plastic; therefore, they were not a concern around potential electrical sources. The vacuums were noisy in the areas being cleaned due to the unfurnished state of the units, and accordingly, the enhanced acoustics.

Shop vacuums are designed to provide easy unload of bulk debris. This type of vacuum typically provides a suction head lift of 48-51 inches of water. The shop vacuums were easy to maneuver even when pulled by the hose. They were also noisy in the unfurnished rooms. The hoses and attachments were larger in diameter than those of the upright vacuums. Crevice tools were larger than some spots to be cleaned. Cartridges loaded quickly with the fine dust being suctioned. Use of tube extensions and extra hose lengths facilitated the cleaning of vertical walls and ceilings. The cartridge filters required vacuuming to be cleaned of caked dust. Once this was completed, the suction increased dramatically.

Commercial quality vacuums are designed for heavy use. This type of vacuum typically provides a suction head lift of 82-93 inches of water. Certain accessories were specially designed for specific applications and required some understanding of their operational adjustments. The added instrumentation facilitated monitoring the operation of the equipment. Fine dust clogged the primary filter cloth easily when used in extreme conditions; however, the HEPA filter when checked visually appeared free of dust. Only the cloth filter required vacuuming. The Nilfisk™ vacuum has a duel motor drive, providing an intense suction allowing for better lift of trapped material than that obtained by off-the-shelf equipment. Each Nilfisk™ vacuum arrived with a 20 amp rated plug that did not conform to the receptacles in the building. The appropriate plug ends were procured and installed. At 92.6 pounds, the vacuum can be handled by one person who maneuvers it in a manner similar to the maneuver of a shopping cart. However, two people are required to ascend stairs with the vacuum.

Wet vacuums are designed to clean horizontal porous surfaces with soap and water (shampoo). The wet vacuums used in the study were an upright model, providing a suction head lift of 103 inches of water. This vacuum was easy for one person to use. The vacuum required hot water to work properly. The hot water had to be hand carried to the site in five-gallon buckets because hot water was not available. The vacuum could spray water or soap individually or both soap and water at the same time. It uniformly sprayed soap and water on the carpet. The soap and water was allowed to penetrate the carpet, and was then suctioned off of the carpet. This spraying capability facilitated the removal of dirt, dust, and debris from the surface.

Use of Swiffer® brand cloths was discontinued quickly because of the small coverage area provided. The cloth quickly loaded with dust and dried out. It then streaked the surfaces being cleaned. Both wet and dry types of Swiffer® cloths were used with the same result. Windex® brand cleaner and water was used as a replacement for the Swiffer® cloth.

Use of water without soap on horizontal surfaces resulted in smearing and re-deposit of the dirt.

Water and ammonia-based cleaner (Windex®) did not smear. No difference in the cleanliness of the carpets based on use of water or soap and water was observed visually.

2.4 Cleaning Methods

Eleven tests were developed to evaluate eleven different cleaning methods that may have been used to clean residential and commercial spaces. To evaluate the equipment under comparable and varying conditions, tests were performed using similar equipment to clean areas that had both significant and minimal dust. Every attempt was made to evaluate each test on two spaces. An outline of the tests and prescribed cleaning methods follows:

Test 1 (A, B)

A. Cleaning was conducted using residential quality upright vacuums and shop vacuums that are available from Hoover®, Eureka®, Ridgid® and Craftsman®, as well as wet wiping.
B. Cleaning was conducted with the vacuums used in Test A, with the addition of an AFD, as well as wet wiping.

Test 2 (A, B)

A. Cleaning was conducted in up to two units using HEPA-filtered upright vacuums and HEPA-filtered shop vacuums available from Hoover®, Eureka®, Ridgid®, and Craftsman®, as well as wet wiping.
B. Cleaning was conducted with the vacuums used in Test A, with the addition of an AFD, as well as wet wiping.

Test 3 (A, B)

A. Cleaning was conducted in up to two units using commercial quality HEPA-filtered vacuums manufactured by Nilfisk™ Advance Vacuum Systems, as well as wet wiping.
B. Cleaning was conducted in up to two units with the vacuums used in Test A, with the addition of an AFD, as well as wet wiping.

Test 4 (A, B ,C, D, E)

A. Cleaning was conducted in commercial units and common areas using commercial quality HEPA-filtered vacuums manufactured by Nilfisk™ Advance Vacuum Systems[8]. An AFD was used. Debris that could not be vacuumed was manually removed and disposed.
B. (Wet Wiping.) Additional cleaning of wall surface areas was conducted to remove any residues that may not have been removed by vacuuming. Wiping of the walls with a damp soapy cloth was performed to remove residual dust that may have adhered to the walls from the force of the collapse. Wet wiping of walls was performed in the Chiropractor's Office, the Mattress Store, Unit 3C, and Unit 3B.
C. (Wet Vacuum.) Wall-to-wall carpeting was present in the Chiropractor's Office, and the Mattress Store. The Chiropractor's Office was wet-vacuumed using hot water; the Mattress Store was wet-vacuumed using hot water and carpet shampoo.
D. (HVAC Cleaning.) HVAC systems are located in the Chiropractor's Office, the Mattress

[8]Test method 4A is the same as test method 3B. Both test methods use the same cleaning equipment. Test method 4A was used in commercial units; test method 3B was used in residential units.

Store, Lemongrass Grill, and The Food Exchange. These systems were cleaned by professional duct cleaning companies using standard cleaning procedures.

E. (Wet Wiping.) Wet wiping was accomplished using water only on horizontal and vertical surfaces. This cleaning procedure was applied in the Chiropractor's Office (bathroom tile floor and desktop), the Mattress Store (vinyl tile floor and window ledge), and the Barber Shop (vertical and horizontal surfaces).

Modified Scope A – Lower Manhattan Cleaning Procedure

Added as an amendment to the original work plan, this cleaning method mirrored the procedure that EPA and NYC are implementing as part of the Indoor Air Residential Assistance-WTC Dust Cleanup Program, with the exception of the cleaning of personal belongings. This procedure is presented in Attachment F, *Scope A - Lower Manhattan Cleaning Procedure.*

2.5 Mobilization

Site activities began on June 17, 2002. Activities included mobilizing equipment and supplies, establishing a temporary office, identifying emergency support services and contacting vendors to arrange for specialized services and delivery of bulk items. Consolidated Edison was contacted and installed a shunt from the main trunk line to the building to provide electricity. Mobilization was completed by June 21, 2002. On June 24, 2002, WRS laborers arrived at the study building to begin work. Work continued through the third week of October 2002.

Prior to commencement of the study, bulk samples were collected from three units in the building. Samples were collected from units that contained excessive amounts of dust, in an attempt to characterize the asbestos concentration in dust from worst case locations in the building. Samples were collected from the Chiropractor's Office, the Mattress Store and residential Unit 5C. Analysis of the samples indicated that less than one percent asbestos was present. Therefore, NYC asbestos licensing and certification regulations did not apply to the project. The federal OSHA asbestos standard (29 CFR 1926.1101) did apply to the project. At EPA direction, WRS assigned a team of asbestos-trained personnel to the project. Two licensed supervisors and two licensed workers were part of the operations team. All field operations personnel had completed all applicable training.

2.6 Cleaning of Residential Units

The cleaning of each of the thirteen residential units was accomplished using the vacuum equipment type prescribed by the designated test, as presented in Attachment H, *Synopsis of Cleaning Methods by Building Area and Fact Sheets*. Management of waste was accomplished as the cleaning activities occurred. The sequence of procedures followed in each residential unit was the same.

Security. The first cleaning activity in each unit related to the securing of potential access points from air infiltration, such as wall and window mounted air conditioning units. It was necessary to clean the access points as they were secured, to ensure that use of the access points after cleaning activities would not result in re-contamination. In order to limit unauthorized access to the building and to protect equipment and supplies during daytime work hours, previously damaged windows were secured and the entrance door to the building was continuously monitored. At the

end of the work day, the entrance door on the Cedar Street side of the building was locked.

Where glass windows had been blown out, the temporary wood panels that had been installed for site security purposes were removed and reinstalled to afford complete closure. Intact windows were opened, and the jambs, sashes, and sills were cleaned thoroughly. The windows were then closed. In windows where an air conditioning unit was present, the air conditioning unit was removed from the window. The temporary protection on the exterior of the window was removed. The window cabinet that had housed the air conditioning unit was vacuumed, then covered with plastic to prevent air filtration. The air conditioning unit was vacuumed to remove loose dust, wrapped in plastic, and disposed. Wall mounted air conditioning units were removed from the wall, and sealed in plastic. The wall cabinet that had housed the air conditioning unit was vacuumed, then covered with plastic to prevent air infiltration. The air conditioning unit was vacuumed to remove loose dust, wrapped in plastic, and disposed. Disposal of the air conditioning units and installation of new self-contained ductless systems was performed by the building owner following completion of the study.

Waste Management. At the onset of the project, due to limited space outside the building, it was necessary to line the hallways with plastic and to temporarily locate the items to be disposed, including personal possessions, until a roll-off container could be procured. As cleaning progressed, waste was accumulated and staged in the common areas by the elevator until a sufficient quantity was gathered to fill a roll-off container. The waste was wrapped in plastic to avoid cross-contamination of the hallways leading to the roll-off container. The removed materials were hand-carried through the hallways and down the stairwell to the roll-off container located outdoors, because the elevator was not functioning.

Vacuuming. Vacuuming commenced at the entrance doorway of the unit. Working from the ceiling to the floor, toward the furthest area of the unit, all surfaces were vacuumed of loose dust and debris. Walls, ceilings, doors, pipes, ledges, closets, cabinets, shelving, trim, fixtures, and electrical outlets were vacuumed as they were encountered. Upon reaching the furthest point in the unit, the direction of cleaning was reversed and the same cleaning procedures were followed while returning to the point of origin at the entrance doorway. This procedure accomplished the cleaning of each unit twice using the designated cleaning method.

Wet Wiping. Wet wiping was performed on all horizontal surfaces to remove dust. The WRS cleaning crew applied wet wiping to all horizontal surfaces, including the floor, as they progressed from the furthest point of the interior of the unit back to the door. Wet wiping was the last activity performed in the unit.

Cleaning Air Conditioning Units. As noted in Section 2.1 above, two types of air conditioning systems were used in the residential living spaces: window/wall mounted air conditioners, and ceiling-mounted ductless air conditioners with remote condenser/compressor units. Bathroom fans also presented airflow routes that needed to be cleaned. Ceiling-mounted air conditioners were cleaned using HEPA-filtered equipment. The grills were removed to provide access to the interior. The condenser and compressor units on the roof were visually inspected and found to be clean. Removal of the ceiling cover to access the bathroom fan assemblies was necessary. The fan and motor were vacuumed; the fan housing was wet wiped. The interior of the exhaust duct was vacuumed to the first foot. The unit was reassembled and covered with poly sheeting.

Baseboard heating components, including the hydronic finned radiation systems, were cleaned. The protective covers were removed to expose the heating elements. The fins were then vacuumed and brushed simultaneously to remove dust. The space located under the heating element was vacuumed. The protective covers were reattached.

Cleaning of Refrigerators, Dishwashers and Stoves (including exhaust fans). Prior to cleaning refrigerators, the appliance was unplugged and checked for food contents. If present, food was removed, bagged and disposed. The coils, underbody, compressor compartment, and back of each refrigerator was cleaned. Dust from the cooling coils was cleaned by elevating the appliance and simultaneously using vacuums and specialized brushes. Upon completing these activities the floor area where the refrigerator had been located was cleaned. Prior to cleaning, each stove unit was disconnected from its electric receptacle and gas line. Old exhaust fan lights and filters were removed and replaced. The first foot of the exhaust duct was vacuumed. The stove hood was vacuumed. Prior to cleaning dishwashers, the toe plate was removed and dust was vacuumed from under the appliance. After cleaning, all appliances were staged on plastic for subsequent removal by the owner, who had decided to replace them.

Pre-Cleaning and Post-Cleaning Sampling. Pre-cleaning and post-cleaning sampling was performed to measure levels of COPC. Sampling data was reviewed and a decision regarding the need for additional cleaning was made. Wipe samples were collected from solid surfaces, both vertical and horizontal. A micro vacuum technique was used on sofas, mattresses, and porous materials. All sampling was conducted in accordance with the Quality Assurance Project Plan (QAPP) contained within Attachment G, *Sampling and Analysis Plan*.

2.7 Cleaning of Commercial Units, Common Areas and Basement

The cleaning of each commercial unit was accomplished using the vacuum equipment type prescribed by the designated test, as presented in Attachment H, *Synopsis of Cleaning by Building Area and Fact Sheets.* Management of waste was accomplished as the cleaning activities occurred. The sequence of procedures for vacuuming, wet wiping, waste management, and pre-cleaning and post-cleaning sampling mirrored the procedures used in the residential units. Cleaning of the HVAC systems and carpets presented the only significant differences from the procedures used to clean the residential units. A discussion of the procedures used to clean the HVAC systems and carpets in the commercial units and the procedures used to clean the common areas and the basement follows.

HVAC Systems

The Chiropractor's Office is located in the north end of the building at the Liberty Street address. It contains four patient rooms and an administrative section with a waiting room and a half bath facility. The air conditioning system in the unit is suspended from the third floor deck above a suspended acoustical tiled ceiling, located in the south end of the office space. It utilizes a common closed return to convey air to the blower cabinet. The supply trunk runs northward, supplying air to the balance of the rental space through supply diffuser grills. The system's condenser/compressor unit is located on the building's atrium roof area at the second floor elevation.

The Mattress Store is located in the north end of the building at the Liberty Street address. Space

design is open throughout the unit, with a half bath, utility closet, and coat closet located in the south end of the room. The A/C system air handler is suspended under the third floor deck, above the suspended acoustical tiled ceiling. The system has two closed return air grills, a blower cabinet, and a supply trunk with a four way directional supply grill. The system's condenser/compressor unit is located in the building's atrium roof area at the second floor elevation.

The procedures used to clean the Chiropractor's Office and Mattress Store were identical. They mirrored the procedures used by HVAC cleaning companies when responding to ordinary HVAC cleaning requisitions. The following cleaning activities were conducted, in the following order:

1. A clean plastic barrier was installed on the floor surface, three feet to either side of the suspended HVAC system, from the return intake to the furthest supply grill.
2. Access points were selected at the return and supply sides of the duct system. A HEPA-filtered vacuum collection system was installed at the end of the supply run to collect internal dust.
3. A rotating brush system was used to dislodge dust in the direction of the vacuum collection system.
4. Degreasing agents were used on the HVAC internal coil units and cleaned. Supply grills were cleaned in a similar fashion.
5. A biocide agent was applied to the duct's internal components and allowed to dry.
6. An encapsulant was applied to the internal surfaces in order to ensure that residual dust was sealed in.
7. The work area was cleaned of all equipment and plastic protection.
8. The system was visually inspected at the air handling unit access panels for view of internal components. The duct work was visually inspected for dust in the return and in the supply lines.

Carpet Cleaning (study)

Two methods were utilized to clean the carpets in the Chiropractor's Office and the Mattress Store: 1) Nilfisk™ vacuum with HEPA filtration, and 2) wet vacuuming. Carpets were wet-vacuumed in the Chiropractor's Office and in the Mattress Store, using standard carpet shampooing equipment available to the public at rental stores. The carpets were cleaned twice, sampled, and disposed as porous material. Initially, the carpets were cleaned running in the direction of the room from front to back (Liberty Street to Cedar Street). The carpets were then cleaned again, in a direction crossing the room from side to side.

Warm water only was used in the Chiropractor's Office. Soap (carpet shampoo) and warm water were used in the Mattress Store. Seven-in-One™ brand professional carpet shampoo, manufactured by Kent Investment Corporation, was diluted at two ounces per gallon of water. This dilution achieved 1,400-2,000 square feet of cleaning coverage.

Common Areas (study)

The common areas were the first areas of the building cleaned, in order to provide a dust-free area for Level D entry through the common spaces, and to provide a safe location for equipment storage. All foyers, stairways, and halls were vacuumed using commercial quality HEPA vacuums. All horizontal and vertical surfaces in the common areas were wet wiped where

possible. The common areas were re-cleaned as necessary due to traffic.

Stairwells were cleaned commencing at the Cedar Street doorway vestibule starting in the stairwell at the ground entrance and proceeding to the rooftop access door. The stairwells were then re-cleaned, following the same route back. The ceilings, walls, handrails, balusters, treads, risers, fire protection equipment, lighting, and trim were cleaned.

The hallways of each floor were accessed through fire doors at the stairwell platform for each floor. Access to each floor remained closed until each stair well had been cleaned from bottom to top, and from top to bottom. The hallways were cleaned in the same manner as the stairwells, except that not all of the hallway walls were wet wiped. The second floor hallway floor was covered with vinyl tile. It was wet wiped. However, the third and fourth floor walls were made of plywood. Wallpaper originally applied to the wall surfaces had been removed, leaving a rough paste finish that was not conducive to wet wiping.

Each hallway contained a utility room with a wall-enclosed trash chute that led to the basement of the building. Some items were discovered in the utility closets. Boxes that were unopened were vacuumed and left in place. Other items were packaged for disposal. The utility areas did not seem to be impacted by WTC dust.

An elevator accessing each floor was located on the Cedar Street side of the building. It was not operational for the first two months of the project. Eventual repair of the elevator by others allowed access to the inner compartment. The elevator cab and the exterior top of the cab were vacuumed.

Basement (study)
The basement of the building is comprised of separate rooms: a trash compactor room, a motor room associated with the elevator shaft, a common access area from the street, and a fire protection equipment room. The brick walls of the basement were encrusted with mud, indicating a high water level at some time in the building's history. These rooms were cleaned using commercial HEPA equipment. Loose debris related to stone and mortar deterioration was vacuumed from the walls and ledges of the base of the elevator shaft. Small rocks, paper, debris, and rodent carcasses were removed.

2.8 Cleaning of Non-Study Commercial Units

As discussed in Section 2.1, three commercial units were cleaned at the conclusion of the study, although they were not part of the study: Lemongrass Grill, the Food Exchange and the Barber Shop. These units were cleaned using cleaning methods as presented in Attachment H, *Synopsis of Cleaning Methods by Building Area and Facts Sheets*.

The sequence of procedures for vacuuming, wet wiping, waste management, and pre-cleaning and post-cleaning sampling mirrored the procedures used in the residential units. Management of waste was accomplished as the cleaning activities occurred. Disposal of debris was handled in the same manner as in the residential units. Cleaning of the HVAC systems presented the only significant difference from the cleaning procedures used in the residential units. A discussion of the procedures used to clean the HVAC systems follows.

Lemongrass Grill occupies 2,351 square feet of space. It utilizes a self-contained re-circulating HVAC system, with no outdoor supply air, that is suspended above the floor in the south end of the restaurant. Return air enters the unit through a grill located in the front side of the unit. The air-handling unit is accessible through access doors on either side of the unit. The unit is enclosed with one-half-inch sheet rock. A supply trunk runs northward through the restaurant with three supply branches. A second source of duct is located adjacent to an exhaust hood for the cooking equipment. This system is separate from the HVAC and supplies makeup air to the hood area. Ambient air is drawn in from a grill above street level to a blower inside the building that leads to a supply trunk. Four supply grills are adjacent to the food exhaust hood.

The Food Exchange is a restaurant that occupies 2,324 square feet of space, running from Cedar Street at the South end through to Liberty Street on the north end. Two side-by-side air handlers that share the supply air duct system are supported above a decorative tinned acoustical ceiling. The supply duct system splits mid-building and runs approximately fifty feet in two opposite directions. A water cooling tower is located outside the building on the building atrium. The air handlers use a common air return with no makeup air being drawn from outside the building. Access to the duct work on the north side of the building must be through the access grill openings, because the ceiling is enclosed in sheet rock. Access to the duct work on the south side is through a suspended ceiling. The ceiling tiles in the area of the duct work and the insulation wrapping the duct work were removed prior to cleaning the ducts. The space from the suspended ceiling to the upper deck, including the grid work, was vacuumed. An isolation wall was fabricated to bar the north side from the south side.

The services of an HVAC consultant were secured to develop site-specific cleaning procedures for the Lemongrass Grill and the Food Exchange, and to stipulate necessary controls, protective measures, and standards for the cleaning and sampling confirmation process. These procedures are provided in Attachment I, *HVAC Cleaning Procedures*.

The Barber Shop is situated below grade. The unit contains a ductless A/C system with a remote condenser/compressor unit. The condenser/compressor unit is located above the entrance door that accesses Liberty Street. The air handling system and the condenser/compressor unit was cleaned in an effort to remove accumulated residual dust and debris so that the units could be handled for disposal by the building owner.

2.9 Cleaning of Building Exterior/Roof

Cleaning of the building exterior and the rooftop was accomplished and monitored by the NYCDEP. NYCDEP hired an asbestos abatement contractor to accomplish this task. Cleaning of the building exterior was initiated at approximately the same time that cleaning of the interior of the building began. NYCDEP subcontractors were required to vacuum and wash the building exterior twice over a two-day period before acceptable results were achieved.

The building has two roof elevations: An atrium roof at the second floor level, and a roof at the fifth floor level. Four residential compressor/condenser units are situated on the fifth floor roof. These service ductless air conditioning units in the residential apartments. Prior to the study, these units were cleaned by outside contractors. Three commercial compressor/condenser units are situated on the atrium roof of the building. These units service the Chiropractor's Office, the

Mattress Store and the Lemongrass Grill. These three units were cleaned as part of the study. The Food Exchange air conditioning system utilizes a water-cooling tower located on the atrium roof that was also cleaned.

2.10 Summary of Cleaning Activity

Table 4.0 presents an overview of the tests used to clean residential and common areas of the building as well as a description of that area. A full description of the cleaning activities in each area can be found in Attachment H, *Synopsis of Cleaning Methods by Building Area and Fact Sheets*.

Table 4.0
Summary of Cleaning Activity

Unit/Area	*Equipment Used*	*Cleaning Method*	*Wet Wipe*		*First Cleaning*	*Second Cleaning*	*Third Cleaning*
2A	Ridgid® shop vacuum and Hoover® upright, AFD	Test 1B	Horizontal Surfaces	soap/water	**Asbestos/ overload**	Cleared for COPC	
2B	Industrial HEPA vacuum	Test 3A	Horizontal Surfaces	soap/water	Cleared for COPC		
2nd Floor Common Area	Industrial HEPA vacuum, AFD	Test 4A	Horizontal & Vertical Surfaces	soap/water	Cleared for COPC		
3A	Craftsman® shop vacuum and Eureka® upright, w/HEPA and AFD	Test 2B	Horizontal Surfaces	soap/water	Cleared for COPC		
3B	Industrial HEPA vacuum, AFD	Scope A	Horizontal & Vertical Surfaces	soap/water	**Asbestos/ overload and lead (wipe) exceedence**	Cleared for COPC	
3C	Craftsman® shop vacuum and Eureka® upright	Test 1A	(1A)(1A) (3B) Horizontal & Vertical Surfaces	soap/water	**Asbestos/ overload** and lead (micro vacuum) exceedence	**Asbestos/ overload and MMVF (air) exceedance**	Cleared for COPC
	Industrial HEPA vacuum, AFD	Test 3B					
3D	Ridgid® shop vacuum and Hoover® upright	Test 1A	Horizontal Surfaces	soap/water	**Asbestos/ overload**	Cleared for COPC	
3rd Floor Common Area	Industrial HEPA vacuum, AFD	Test 4A	Horizontal & Vertical Surfaces	soap/water	Cleared for COPC		
4A	Craftsman® shop vacuum and Eureka® upright, HEPA	Test 2A	Horizontal Surfaces	soap/water	**Asbestos/ overload and alpha-quartz (air) exceedence**	Cleared for COPC	
4B	Ridgid® shop vacuum and Hoover® upright, HEPA and AFD	Test 2B	Horizontal Surfaces	soap/water	Cleared for COPC		
4C	Craftsman® shop vacuum and Eureka® upright	Test 1A	Horizontal Surfaces	soap/water	Cleared for COPC		

Table 4.0 **Summary of Cleaning Activity**							
Unit/Area	***Equipment Used***	***Cleaning Method***	***Wet Wipe***		***First Cleaning***	***Second Cleaning***	***Third Cleaning***
4D	Ridgid® shop vacuum and Eureka® upright, HEPA	Test 2A	Horizontal Surfaces	soap/water	**Lead (wipe) exceedance**	Cleared for COPC	
4th Floor Common Area	Industrial HEPA vacuum, AFD	Test 4A	Horizontal & Vertical Surfaces	soap/water	Cleared for COPC		
5A	Industrial HEPA vacuum, AFD	Test 3B	Horizontal Surfaces	soap/water	**Lead (wipe) exceedance**	Cleared for COPC	
5C	Industrial HEPA vacuum	Test 3A	(3A)(3A)(3B)	soap/water	**Asbestos/ overload and MMVF (air) exceedance**	**Asbestos/ overload and MMVF (air) exceedance**	Cleared for COPC (asbestos: modified-aggressive sampling)[9]
	Industrial HEPA vacuum, AFD	Test 3B	Horizontal Surfaces				
5D	Industrial HEPA vacuum , AFD	Test 3B	Horizontal Surfaces	soap/water	Cleared for COPC		
5th Floor Common Area	Industrial HEPA vacuum, AFD	Test 4A	Horizontal & Vertical Surfaces	soap/water	**Asbestos/ overload**	Cleared for COPC	
Cedar St. Stairwell	Industrial HEPA vacuum, AFD	Test 4A,4B	Horizontal & Vertical Surfaces	soap/water	Cleared for COPC		
Elevator Shaft Basement Area	Industrial HEPA vacuum, AFD	Test 4A	No Wet Wipe		Cleared for COPC		
Liberty St. Stairwell	Industrial HEPA vacuum, AFD	Test 4A,4B	Horizontal & Vertical Surfaces	soap/water	**Alpha-quartz (air) exceedance**	Cleared for COPC[10]	

2.11 Difficulties Encountered and Resolutions

A discussion of the difficulties encountered during the cleaning portion of the study, along with a discussion of how they were resolved is presented below.

Site Conditions

Rummaging. Site debris, abandoned possessions, and construction related waste materials were wrapped in plastic sheeting, and carried to a staged roll-off container. When filled to capacity, the

[9] Asbestos air clearance criterion was met using modified aggressive air sampling protocol; however, the clearance criterion was not met using aggressive air sampling.

[10] Silica analytical methods were note received until after project completion. However, a single elevated sample result in a low occupancy area of the building was not considered to be a health hazard. Therefore, no further cleaning was conducted.

containers were transported off site for disposal, and replaced with empty containers. It was discovered that people were rummaging through the contents of the roll-off containers after personnel left the site for the day. To deter this activity, it was necessary to monitor the debris box at night. The staff of the cleaning contractor was utilized to provide security. Shift hours were adjusted to add two-hour increments of coverage by crew members until midnight. This eliminated the rummaging.

Elevator. The elevator was out of service from project commencement until late August. Therefore, it was necessary to manually carry individual items down the stairways of many floors for disposal in the roll-off container. Many unanticipated labor hours were dedicated to hand carrying the disposable items.

Hot Water. The building was without gas service; therefore, hot water was unavailable. Hot water was only used for the shampooing of carpets. Hot water was obtained from a local delicatessen and manually transported in five-gallon buckets as needed. Cold water was used to clean the remainder of the facility.

Electric Service. EPA contacted Consolidated Edison directly to install a shunt from the main trunk line to the building to provide electricity by the mobilization date.

Office Space. The location and the condition of the building did not allow for office space. Nor was there sufficient space proximal to the site to set up an office trailer. Therefore, office space to accommodate copying and administration was established in a hotel several blocks away. Because the building was without telephone service, in order to enable continuous communication, personnel carried cell phones at all times.

Spoiled Food. At project commencement, information obtained by others indicated that all foodstuffs in the building were removed shortly after September 11, 2001. However, a walk-in box in the Lemongrass Grill contained perishable food that had been overlooked. Large quantities of fish and shrimp were discovered that had been spoiling for nine months. The odor was noxious. Additionally a previously undiscovered chest freezer was filled with spoiled food including fish, shrimp, beef and miscellaneous food items that required removal. Approximately 200 pounds of spoiled food was collected, double bagged and disposed of utilizing a NYC Sanitation Truck. Water from melted ice and rotting food debris at the bottom of the freezer was removed and the area was sanitized. Similarly, the refrigerators in the apartments were to have been emptied of all solid contents by others shortly after the World Trade Center attack. However, residual foods remained. These spoils were also removed and disposed. The building owner subsequently disposed of all kitchen appliances, including the refrigerators.

Rodents. Dead rats and mice were prevalent in the basement areas, in the elevator shaft, and in some rental units. Rodent droppings were evident on floor surfaces throughout these areas. The remains of rodents were collected, bagged and deposited in the roll-off containers. Live rats were encountered in the Lemongrass Grill and the Food Exchange. The assistance of the building owner was sought to hire an exterminator.

Coordination

Tenant Response. Residents did not consistently appear at the scheduled time for appointments

to address disposition of personal belongings. This caused slight delays to cleaning efforts. It was necessary to adjust the cleaning schedules to minimize the delays.

Parking. Although an arrangement had been made with the Office of Emergency Management (OEM) for EPA and its subcontractors to park vehicles on Cedar Street, the NYC Police Department ticketed vehicles without regard to established verbal agreements. Time expended to respond to tickets was significant. Communications with the OEM were helpful at times.

Building Contractor Coordination. The Baldwin Realty Company, the resident management company of the building owner, had not performed any repairs on the building since September 11, 2001, because the entire area had been off limits to the public. Shortly after the study began, the management company's repair and maintenance contractors commenced activities including: replacement of windows, doors, sashes, and suspended ceilings; repair of the elevator; and removal of refrigerators and stoves. EPA and its contractors were required to closely coordinate activities with these contractors to avoid interference with the study, and to ensure that areas were cleaned and sampled before the contractors commenced their work. At onset of the project, meetings were scheduled to discuss activities and to provide a schedule of cleaning activities. The intent was to clean and clear areas prior to the performance of any maintenance activities. Prior to commencing cleaning, signs were erected and caution tape was placed around the areas undergoing cleaning, to avoid interference by other contractors. Unfortunately, work conducted by window repair and floor contractors created dirt and debris that necessitated re-cleaning of some units. This situation occurred between sampling events only once, in Unit 5C, between the collection of air samples for asbestos.

Health and Safety Concerns

PPE. The only health and safety concern related to PPE was fogging goggles. Fogging goggles caused personnel some degree of visual difficulty. The problem was solved by applying an anti-fogging agent to the lens of the goggles. The requirement for goggles was downgraded to a requirement for safety glasses when it was determined that the amount of dust produced was not irritating to an employee's eyes.

Personal Air Sampling. A very small percentage of the personal air samples for asbestos were overloaded with dust and could not be analyzed by the laboratory.

Baseboard Heating Cleaning. Intensive labor was required in order to remove visible dust from the baseboard heating systems.

Heat Stress. Heat exhaustion, heat cramps, and heat stroke were a major concern due to the extreme heat experienced during cleanup activities. The heat stress hazard was mitigated by mandating frequent breaks to replenish fluids and lower core body temperatures.

Heavy Lifting. All units contained heavy objects that were moved, disposed of, or lifted to enable cleaning underneath. The Site Health and Safety Officer frequently instructed WRS employees relative to proper lifting techniques. All personnel were directed to obtain assistance when lifting objects over fifty pounds. The non-functioning elevator resulted in a quantity of heavy lifting that significantly exceeded what had been anticipated at project commencement.

3. Sampling Activities

3.1 Baseline Sampling

Prior to initiating cleanup activities, bulk composite samples were collected in each of the three units which had sufficient dust present to collect a bulk sample. These Units included 5C, and the two commercial units on the second floor (Mattress Store, Chiropractor's Office). The bulk samples were analyzed for alpha-quartz, MMVF, lead, PAH, dioxins/furans, and asbestos. Due to insufficient volume, the sample collected from Unit 5C was not analyzed for PAH or dioxins/furans.

EPA's evaluation of the analytical data from the bulk composite sampling event was utilized in identifying COPC concentrations present in the settled dust, and assisted EPA in determining the applicability of regulatory standards and in identifying potential health and safety concerns. Analytical results of the bulk sampling are not included in this report.

In addition to the collection of bulk composite samples, baseline air samples were also collected. These samples were collected from the breathing level (5-6 ft.) and from the main living area of the units which, based upon visual observations, were both the least and the most impacted by the WTC disaster. Samples collected from the least impacted apartments (Units 3A and 3B) represented a best case test and were analyzed for asbestos and MMVF. Samples collected from the most impacted areas (Mattress Store, Chiropractor's Office) represented a worst case test and were analyzed for dioxin/furans, PAH, asbestos and MMVF.

EPA's evaluation of the baseline air sampling event determined that the airborne concentrations of PAH and dioxin/furans were not a health concern; therefore, the collection of additional air samples of these parameters was not necessary. This decision was based on the analysis of baseline bulk and air PAH and dioxin/furan samples which were collected from the most severely impacted units. As the air samples did not contain PAH or dioxin/furans at concentrations above the stringent primary clearance criterion as established in the COPC/Benchmarks Report[11], EPA determined that airborne PAH or dioxin/furans would also not be present in the other less impacted units. EPA's decision to eliminate PAH and dioxin/furan analyses for air samples was later confirmed through the collection of reference samples in Unit 4C. These samples were analyzed for PAH and the analytical result was found to be below the clearance criterion of 0.2 $\mu g/m^3$.

3.2 Pre-Cleaning Sampling

Prior to cleaning activities, wipe samples were collected from each of the thirteen residential units and the two commercial units included in the study (Chiropractor's Office, Mattress Store). The wipe samples were collected from a 10 cm x 10 cm area using dedicated, disposable templates which were left in-place. One sample was collected from the surface of each of the following four non-porous locations within each unit: ceiling, wall, bare floor, and horizontal surface (e.g., counters, tables, dressers, window sills). All samples were analyzed for asbestos, MMVF, lead, PAH, dioxins/furans, and alpha-quartz. Exceptions to this were the ceiling samples which were

[11] U.S. Environmental Protection Agency. (September, 2002). *World Trade Center Indoor Air Assessment: Selecting Contaminants of Concern and Setting Health-Based Benchmarks*.

analyzed for asbestos only, and horizontal surfaces which were also analyzed for total dust. Generally, pre-cleaning air sampling was not conducted because of concerns that given the presence of significant levels of dust, using the aggressive technique might make overloading the filters more likely.

Pre-cleaning sampling also included the collection of micro vacuum samples from up to six porous surface areas (e.g., carpets, furniture fabric) in twelve of the thirteen residential units, and both commercial units included in the study (Mattress Store, Chiropractor's Office). The samples were collected from a 10 cm x 10 cm area using dedicated, disposable templates which were left in place. Each unit contained a different number of porous surface sample areas, except Unit 4B which did not have any porous surfaces from which to collect a sample. The micro vacuum samples were analyzed for lead and for asbestos (TEM).

3.3 Sampling During Cleaning

All sampling conducted during cleaning activities was undertaken for the purpose of documenting potential worker exposure to asbestos, lead and alpha-quartz. Samples were collected from the breathing zone (5-6 ft.) in the center of the room being cleaned. The pumps were run the entire length of the work day (no less than 8 hours) and were not stopped during breaks. As reflected in Attachment A, *Personal Monitoring Data*, on only one occasion during the study was the permissible exposure level exceeded for alpha-quartz.

3.4 Post-Cleanup Sampling

Post-cleaning sampling conducted was designed to determine if the cleaning methods attained the health-based benchmarks established in EPA's COPC/Benchmarks Report[12]. Following cleanup activities in the thirteen residential and two commercial units, post-cleanup wipe and micro vacuum samples were collected in the same manner as the pre-cleanup samples.

The post-cleanup samples were collected from locations adjacent to the pre-cleanup sampling locations whenever possible. In situations where the pre-cleanup sampling location was now inaccessible, a new sample was collected as close to the initial location as possible. Post-cleanup air samples were collected in each of the thirteen residential units and in each of the two commercial units included in the study. The analyses for these samples included MMVF, alpha-quartz, lead, and asbestos. The building's four hallways, two stairwells, basement and elevator shaft were also included in this sampling event; however, the elevator shaft did not include alpha-quartz analysis.

All of the aforementioned post-cleanup area air samples were collected following a minimum settling period of sixteen (16) hours and included the implementation of aggressive and/or modified-aggressive air sampling techniques. Aggressive sampling employs the use of a leaf blower followed by circulating fans, whereas the modified-aggressive sampling employs the circulating fans without the initial use of a leaf blower. Aggressive sampling was utilized because

[12] U.S. Environmental Protection Agency. (September, 2002). *World Trade Center Indoor Air Assessment: Selecting Contaminants of Concern and Setting Health-Based Benchmarks*.

of its past use in accordance with the Asbestos Hazard Emergency Response Act (AHERA), for determining the effectiveness of asbestos abatement in schools. Modified-aggressive air sampling was also used because it is more representative of long-term trends of typical household activity such as those expected within the study building.

While there is a greater potential for overloading under aggressive sampling conditions, this test is representative of a worst case scenario. Modified-aggressive air sampling, however, has less of a potential for overloading and is typical of household activity patterns. (Difficulties associated with sample overloading are discussed in detail in Section 3.8 below.)

Other post-cleanup sampling efforts were implemented to evaluate the efficiency of the cleaning of the HVAC systems within the two commercial units included in the study (Chiropractor's Office, Mattress Store). Post-cleanup air samples were collected in close proximity to the HVAC return ducts and analyzed for asbestos, MMVF, alpha-quartz and lead.

3.5 Sampling Supplies and Equipment

Table 5.0 specifies the supplies and equipment required and utilized to collect samples, as described in the QAPP.[13]

Table 6.0 specifies the micro vacuum equipment and the National Air Duct Cleaners Association (NADCA)-recommended method for sample collection that was used.

Table 7.0 specifies the air sampling equipment that was used.

[13] The QAPP is presented within Attachment G.

Table 5.0
Wipe Sampling Equipment

Analyte	*Sample Media*	*Wetting Solution*	*Sample Jar*
Asbestos	6inch x 6 inch, Super Polx 1200 Class 10 Cleanroom Wipes	10 ml of a 50/50 mixture of 2-propanol and DI water	4 oz. glass
MMVF	6 inch x 6 inch, Super Polx 1200 Class 10 Cleanroom Wipes	10 ml of a 50/50 mixture of 2-propanol and DI water	4 oz. glass
Alpha-quartz, Calcite, Gypsum, Total Dust	"Ghost Wipes" (SKC Inc., No. 225-2414)	Distilled water	4 oz. glass
Lead	"Ghost Wipes" (SKC Inc., No. 225-2414)	Distilled water	4 oz. glass
PAH's	3 inch x 3 inch, Cotton Gauze	2 ml of acetone	Amber glass or glass jars wrapped in aluminum foil
Dioxins/Furans	3 inch x 3 inch, Cotton Gauze	2 ml of acetone	Amber glass or glass jars wrapped in aluminum foil

Table 6.0
Micro Vacuum Equipment and NADCA-Recommended Method for Sample Collection[14]

Analyte	*Sample Media*	*Flow Rate*	*Sample Pump*
Asbestos	0.45 µm (25 mm) MCE filter micro vacuum cassette	2 L/min.	Diaphram pump
Lead	0.8 µm (37 mm) MCE filter micro vacuum cassette	2.5 L/min.	Diaphram pump
NIOSH 0500	0.8 µm (37 mm) MCE filter matched weight cassette	15 L/min.	Gilian® Air Con-2

[14]Pump flow rates were measured at the start of each day. A primary dry cell calibrator (BIOS DC-Lite) was used to establish the flow rates of the diaphram pump. A Gilibrator-2 high flow wet cell calibrator was used to establish the flow rates of the Gilian® AirCon-2 high volume air samplers. Flow rates were recorded.

Table 7.0 **Air Sampling Equipment**[15]					
Analyte	***Sample Media***	***Flow Rate***	***Sample Period***	***Sample Pump***	***Notes***
Asbestos (TEM and PCM)	0.45 µm and 0.8µm (25 mm) MCEF cassette	10 L/min.	480 min.	Gilian® Air Con-2	None
MMVF	0.45 µm and 0.8µm (25 mm) MCEF cassette	10 L/min.	480 min.	Gilian® Air Con-2	None
Alpha-quartz, Calcite, Gypsum	5 µm (37 mm) PVC cassette	2.5 L/min.	480 min.	SKC Model 224-PCXR8	Aluminum cyclone needed
Lead	0.8 µm (37 mm) MCEF cassette	10 L/min.	480 min.	Gilian® Air Con-2	None
PAH's	2 µm (37 mm) PTFE filter followed by 150 mg, 8 x 110, XAD-2 sorbent tube	2 L/min.	480 min.	Gilian® Air Con-2	None
Dioxins/Furans	32 mm quartz filter followed by polyurethane foam (PUF)	15 L/min.	56 hour	Gilian® Air Con-2	One

3.6 Sample Analysis and Management

Laboratories Utilized and Analyses Performed

Inorganic analyses, which included MMVF, alpha-quartz, calcite, gypsum, lead, total dust, pH and total particulates not otherwise specified (NIOSH 0500) were performed by EMSL Laboratories (EMSL), at the corporate headquarters located at 107 Haddon Avenue, Westmont, NJ. The analyses for asbestos using PCM, PLM, and TEM were performed by EMSL Laboratories, 307 West 38th St., New York, NY. Organic analyses were provided by Paradigm Analytical, 2627 North Chase Parkway SE, Wilmington, NC. These analyses included PAH and Dioxins/Furans.

[15] Pump flow rates were measured before and after sample collection. Pumps were calibrated before each use and the flow rate was confirmed following the sample period. A primary dry cell calibrator (BIOS DC-Lite) was used to establish the flow rates of the SKC personal sampling pumps. A Gilibrator-2 High Flow Wet Cell Calibrator was used to establish the flow rates of the AirCon-2 high volume air samplers. Calibrating for alpha-quartz, calcite, gypsum and dioxins/furans also required separate flow chambers. Flow rates were recorded on Air Sampling Data Sheets.

Sample Handling and Shipment
Samples transported to EMSL were typically picked up by an EMSL courier the day after sample collection. A small percentage of the EMSL samples, and all of the samples transported to Paradigm Analytical, were shipped via Federal Express. Several samples were damaged during shipment and are so documented in Attachment J, *Reporting of Analytical Results*.

At the conclusion of each sampling event, chain of custody (COC) records were generated electronically using Scribe7 v2.2 software. A copy of the COC records were printed, signed, and shipped with the samples to the lab. The only COC records not generated in this fashion were those for the April 30, 2002 bulk sampling event and the personal monitoring samples collected by WRS.

3.7 Analytical Data

Validation
The validation of all organic and inorganic analytical data was performed in accordance with the QAPP. Validation of inorganic data was performed by Weston. Validation of organic data was performed by EPA Region 2 personnel.

Reporting
All analytical results were tabulated subsequent to validation and are provided in Attachment J, *Reporting of Analytical Results*.

3.8 Difficulties Encountered and Resolutions

Sample Overloading
Initially, many of the asbestos analyses were reported by the laboratory as overloaded. After consulting with the laboratory, it was determined that a reported value of overloaded did not mean that the sample cassette was overloaded with asbestos. Rather, the filter contained particulate matter that could obstruct the field of view of the laboratory analyst.

The only resolution to the problem of sample overloading was the repeated cleaning of the units. It was only after the presence of settled dust was minimized through cleaning that the aggressive and modified-aggressive sampling techniques were able to be used to collect air samples that did not have overloaded filters.

Data Reporting
Given that nearly 3,000 samples were collected and submitted for analysis during the course of the study, EPA's inability to receive laboratory data in a timely manner was a major and ongoing problem. The greatest impact was felt in the scheduling of time and resources for the re-cleaning of the units. The delay in receiving data resulted in the inability to determine if re-cleaning was necessary, which in turn complicated the scheduling of day-to-day work and resource requirements. In many cases, the last minute redirection of the cleaning and sampling contractor's resources was required in an effort to maintain productivity. Furthermore, many of the data packages were incomplete upon receipt, delaying EPA's ability to validate the data in a timely manner, and resulting in delays in issuing final building clearance and the completion of this report.

Another issue which impacted EPA's data reporting was the rejection of data during the validation process. Several wipe samples and one air sample that were analyzed for dioxin/furans were initially reported as rejected. Fortunately, the rejected dioxin/furans data could still be utilized to obtain a Toxicity Equivalent value by calculating an Estimated Maximum Possible Concentration (EMPC) for the dioxin/furans that were rejected. In addition to the dioxin/furans, several lead samples (air, wipe and micro vacuum) were rejected for lab blank, field blank or method blank contamination. The only other sample that was rejected was an inorganic wipe sample that was rejected due to a laboratory blank being out of the control range.

The wipe sampling analytical results for alpha-quartz, calcite, gypsum, cristobalite, tridymite, and total dust were uncertain, thereby rendering the data unusable.

3.9 Modifications to the Study

Modified Aggressive Air Sampling
Both modified-aggressive and aggressive air sampling were used in determining if asbestos air clearance criteria could be achieved in four units. The use of modified-aggressive air sampling was included after repeated problems with overloaded filters were encountered and the further evaluation of aggressive sampling determined that conditions created by aggressive air sampling were not typical of household living patterns.

Wet Wipe using Windex®/Wipe with Water Only
The work plan initially called for use of soap and water to accomplish wet wiping. Windex® brand was used because it is a commonly used cleaner believed to be readily available in most people's homes. Furthermore, it is non-damaging to most surfaces, from wood to fiberglass. Typically, this soap does not "over-suds". It provides an effective detergent-based protection of surfaces when combined with cold water. This was important, because hot water was not immediately available at the project site. During the project, it was determined that a wet wipe procedure using water only would also be evaluated. Water only was used on the desktop and in the bathroom of the Chiropractor's Office, and in the entire Barber Shop. Water only was also used on the vinyl tiles under the carpeted area in the Mattress Showroom.

Horizontal Wet Wipe Only/Horizontal and Vertical Wet Wipe
The majority of the tests of cleaning methods were accomplished using horizontal wet wipe only, to assist in determination of whether vacuuming without wet wiping would result in acceptable cleaning. However, application of both horizontal and vertical wet wipe was tested in Units 3B and 3C. Application of both horizontal and vertical wet wiping in Unit 3B was consistent with the procedures called for relative to testing of Scope A - Lower Manhattan Cleaning Procedures. Unit 3C was selected for an additional test using both horizontal and vertical wet wiping, because that apartment was heavily impacted by WTC dust. The cleaning test called for the use of non-HEPA-filtered vacuums and no AFD.

Use of Swiffer® Brand Cloths
The use of Swiffer® brand cloths for application of wet wipe was also evaluated. Swiffer® cloths were utilized during the cleaning of the first residential unit 5D.

Modified Scope A - Lower Manhattan
Shortly after the study was initiated, the procedures for the WTC Dust Cleanup Program were developed. Once those procedures were finalized, it was decided to include a modified Scope A cleaning procedure developed by the WTC Dust Cleanup Program as one of the cleaning methods in the study.

3.10 Supplemental Sampling Activities

Sampling of "Non-Study" Units
As noted previously, three commercial units located within the study building, but not part of the initial study, were also cleaned by EPA. Pre-cleanup samples collected from two of the three non-study commercial units (Food Exchange, Lemongrass Grill) were limited to the collection of wipe samples from within the HVAC system ducts. Analysis of these samples included lead, MMVF, alpha-quartz and asbestos. Pre-cleanup samples collected from the remaining non-study commercial unit (Barber Shop) included a bulk sample of insulation material which was collected to confirm its asbestos content. Pre-cleanup wipe samples were also collected for analysis of lead, dioxin and PAH.

Post-cleanup area air samples were collected from the three non-study commercial units (Barber Shop, Lemongrass Grill, and The Food Exchange). The analyses for these samples included MMVF, asbestos, alpha-quartz, and lead. Additional air samples were collected in the Lemongrass Grill and The Food Exchange in close proximity to the HVAC return ducts, in order to evaluate the effectiveness of the HVAC cleaning method.[16]

Post-cleanup wipe samples were collected from the inside surfaces of the HVAC ducts within two of the three non-study units (Lemongrass Grill, The Food Exchange) and analyzed for asbestos, MMVF, alpha-quartz and lead. Additionally, samples were collected from the inside surfaces of the ducts within the non-study units utilizing a modified micro vacuum technique; these were collected in accordance with the National Air Duct Cleaners Association (NADCA) ACR 2002 procedures referenced in Attachment I, and analyzed for Total Particulates Not Otherwise Regulated (PNOR) following NIOSH 0500 methodology.

3.11 Mercury Vapor Using Lumex® Analyzer

On June 19, 2002, with the assistance of Dr. Clyde Johnson, Assistant Professor of Environmental Sciences at Medgar Evers College (City University of New York), EPA measured mercury vapor levels in the thirteen residential units, three commercial units, and all common areas in the study building. All sampling was conducted under pre-cleaned conditions utilizing a Lumex® RA-915+ Mercury Vapor Analyzer. Measurements were performed at the breathing zone of infants and adults (6 inches and 5 feet above the floor), using continuous, real-time monitoring and data logging of mercury levels. Further explanation of mercury sampling activities and results are included in Attachment K, *Summary of Mercury Vapor Results Using the Lumex® Vapor Analyzer*.

[16] See Attachment I, *HVAC Cleaning Procedures*.

4. Analytical Results

Introduction

This section reviews analytical results by building area and comparative results. The discussion of analytical results by building area mirrors to a large degree Attachment H, *Synopsis of Cleaning Methods by Building Area and Fact Sheets*, adding information relative to analytical results as they relate to the residential or commercial unit under review. Briefly summarizing the logistics of each unit, the cleaning methods employed, the number of times the unit was cleaned, and providing a narrative description of the analytical results for that unit, the narratives follow the tables in Attachment J, *Key for Analytical Tables and Reporting of Analytical Results*. Attachment J provides the analytical results for each sample that was collected and analyzed. Results reported in units of f/cc are associated with PCM analyses and results that are reported in units of 5>5u/cc are associated with PCMe analyses. A key at the beginning of Attachment J identifies the units associated with each result.

Analytical results are presented in alphabetical order, with details relative to samples that were collected before and after any cleaning event. If a compound is not present for a unit or if a sample type is not present for a compound, then it is not listed in the text. It is of note that in the case of asbestos wipe and micro vacuum samples, a certain number of structures needed to be detected to be reported as being detected above the detection limit. This number was in the range of 6-8 structures. Therefore, asbestos may be indicated as being present even though the sample result is reported as below the detection limit. Samples were analyzed for 23 PAH compounds.

The PAH results are reported as toxicity equivalency factors (TEF) values. These values are the sum of seven of the most toxic carcinogenic PAH[17], modified to reflect benzo[a]pyrene equivalents. The PAH analyses could potentially identify an additional 16 PAH compounds (23 total). These additional compounds are less toxic and in general are not carcinogenic, thus they are not included in the TEF calculations. Fifteen (15) samples that were analyzed for PAH detected at least one of these additional 16 less toxic compounds. These samples, along with the non-TEF modified concentrations detected, are reported in Table 8.0. The values in this table cannot be directly compared to the primary clearance value of 300 ug/m^2 because the primary clearance value represents a TEF value; however, the value listed for each PAH sample in Attachment J reflects the value that can be compared to the primary clearance value.

The dioxin results were modified using a toxicity equivalency method (TEQ), that takes into account the toxicity difference between the different congener groups, and the results are reported in 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) equivalents. The TEQ value reported in the table represents the estimated maximum potential concentration (EMPC). The TEQ EMPC value used data that indicated the presence of a congener above zero but did not meet all of the QA/QC reporting level criteria. This value represents the highest potential concentration of dioxin that may be present.

[17]These seven compounds were used to calculate the toxicity equivalence factor (TEF): benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene.

Table 8.0
PAH Analytical Results

Unit Number	*Sample Identification*	*Category*	*Matrix*	*Analyte*	*Final Results*	*Final Results Units*
2A	9094-W-2A-003	PAH	Wipe	Fluoranthene	320	µg/m^2
2A	9094-W-2A-003	PAH	Wipe	Phenanthrene	250	µg/m^2
2A	9094-W-2A-003	PAH	Wipe	Pyrene	300	µg/m^2
3C	9094-W-3C-003	PAH	Wipe	Anthracene	320	µg/m^2
3C	9094-W-3C-003	PAH	Wipe	Benzo[a]anthracene	760	µg/m^2
3C	9094-W-3C-003	PAH	Wipe	Benzo[e]pyrene	450	µg/m^2
3C	9094-W-3C-003	PAH	Wipe	Benzo[a]pyrene	680	µg/m^2
3C	9094-W-3C-003	PAH	Wipe	Benzo[b]fluoranthene	980	µg/m^2
3C	9094-W-3C-003	PAH	Wipe	Benzo[g,h,i]perylene	520	µg/m^2 *
3C	9094-W-3C-003	PAH	Wipe	Benzo[k]fluoranthene	330	µg/m^2
3C	9094-W-3C-003	PAH	Wipe	Chrysene	830	µg/m^2
3C	9094-W-3C-003	PAH	Wipe	Fluoranthene	1700	µg/m^2
3C	9094-W-3C-003	PAH	Wipe	Indeno(1,2,3-c,d)pyrene	560	µg/m^2 *
3C	9094-W-3C-003	PAH	Wipe	Phenanthrene	1300	µg/m^2
3C	9094-W-3C-003	PAH	Wipe	Pyrene	1600	µg/m^2
3D	9094-W-3D-003	PAH	Wipe	Fluoranthene	280	µg/m^2
3D	9094-W-3D-003	PAH	Wipe	Pyrene	280	µg/m^2
4C	9094-A-4C-016	PAH	Air	Biphenyl	0.12	µg/m^3 *
4C	9094-A-4C-016	PAH	Air	2,6-Dimethylnaphthalene	0.12	µg/m^3 *
4C	9094-A-4C-016	PAH	Air	Fluorene	0.06	µg/m^3 *
4C	9094-A-4C-016	PAH	Air	1-Methylnaphthalene	0.18	µg/m^3
4C	9094-A-4C-016	PAH	Air	2-Methylnaphthalene	0.34	µg/m^3
4C	9094-A-4C-016	PAH	Air	Naphthalene	0.46	µg/m^3
4C	9094-A-4C-016	PAH	Air	Phenanthrene	0.12	µg/m^3 *
4C	9094-A-4C-017	PAH	Air	Dibenzofuran	0.06	µg/m^3 *
4C	9094-A-4C-017	PAH	Air	2,6-Dimethylnaphthalene	0.13	µg/m^3 *
4C	9094-A-4C-017	PAH	Air	Fluorene	0.03	µg/m^3 *
4C	9094-A-4C-017	PAH	Air	1-Methylnaphthalene	0.19	µg/m^3
4C	9094-A-4C-017	PAH	Air	2-Methylnaphthalene	0.35	µg/m^3
4C	9094-A-4C-017	PAH	Air	Naphthalene	0.48	µg/m^3
4C	9094-A-4C-017	PAH	Air	Phenanthrene	0.13	µg/m^3 *
4C	9094-W-4C-003	PAH	Wipe	Fluoranthene	270	µg/m^2
4D	9094-W-4D-003	PAH	Wipe	Benzo[a]anthracene	270	µg/m^2
4D	9094-W-4D-003	PAH	Wipe	Benzo[b]fluoranthene	320	µg/m^2
4D	9094-W-4D-003	PAH	Wipe	Chrysene	300	µg/m^2
4D	9094-W-4D-003	PAH	Wipe	Fluoranthene	580	µg/m^2
4D	9094-W-4D-003	PAH	Wipe	Phenanthrene	410	µg/m^2
4D	9094-W-4D-003	PAH	Wipe	Pyrene	530	µg/m^2
5C	9094-W-5C-003	PAH	Wipe	Benzo[b]fluoranthene	260	µg/m^2
5C	9094-W-5C-003	PAH	Wipe	Fluoranthene	430	µg/m^2
5C	9094-W-5C-003	PAH	Wipe	Phenanthrene	300	µg/m^2
5C	9094-W-5C-003	PAH	Wipe	Pyrene	370	µg/m^2
Barber Shop	9094-W-BS-013	PAH	Wipe	Biphenyl	380	µg/m^2

Table 8.0 **PAH Analytical Results**						
Unit Number	***Sample Identification***	***Category***	***Matrix***	***Analyte***	***Final Results***	***Final Results Units***
Chiropractor's Office	9094-A-CHR-012	VOCs	Air	Acenaphthene	0.18	µg/m^3
Chiropractor's Office	9094-A-CHR-012	VOCs	Air	2,6-Dimethylnaphthalene	0.21	µg/m^3
Chiropractor's Office	9094-A-CHR-012	VOCs	Air	1-Methylnaphthalene	0.28	µg/m^3
Chiropractor's Office	9094-A-CHR-012	VOCs	Air	2-Methylnaphthalene	0.58	µg/m^3
Chiropractor's Office	9094-A-CHR-012	VOCs	Air	Naphthalene	0.83	µg/m^3
Chiropractor's Office	9094-A-CHR-012	VOCs	Air	Phenanthrene	0.21	µg/m^3
Chiropractor's Office	9094-A-CHR-013	VOCs	Air	Acenaphthene	0.19	µg/m^3
Chiropractor's Office	9094-A-CHR-013	VOCs	Air	2,6-Dimethylnaphthalene	0.22	µg/m^3
Chiropractor's Office	9094-A-CHR-013	VOCs	Air	1-Methylnaphthalene	0.28	µg/m^3
Chiropractor's Office	9094-A-CHR-013	VOCs	Air	2-Methylnaphthalene	0.57	µg/m^3
Chiropractor's Office	9094-A-CHR-013	VOCs	Air	Naphthalene	0.82	µg/m^3
Chiropractor's Office	9094-A-CHR-013	VOCs	Air	Phenanthrene	0.22	µg/m^3
Chiropractor's Office	9094-W-CHR-002	PAH	Wipe	Fluoranthene	190	µg/m^2*
Chiropractor's Office	9094-W-CHR-002	PAH	Wipe	Phenanthrene	160	µg/m^2*
Chiropractor's Office	9094-W-CHR-002	PAH	Wipe	Pyrene	180	µg/m^2*
Chiropractor's Office	9094-W-CHR-003	PAH	Wipe	Fluoranthene	230	µg/m^2*
Chiropractor's Office	9094-W-CHR-003	PAH	Wipe	Phenanthrene	180	µg/m^2*
Chiropractor's Office	9094-W-CHR-003	PAH	Wipe	Pyrene	230	µg/m^2*
Mattress Store	9094-W-MAT-003	PAH	Wipe	Fluoranthene	570	µg/m^2
Mattress Store	9094-W-MAT-003	PAH	Wipe	Phenanthrene	330	µg/m^2
Mattress Store	9094-W-MAT-003	PAH	Wipe	Pyrene	520	µg/m^2
Mattress Store	9094-W-MAT-004	PAH	Wipe	Fluoranthene	120	µg/m^2*
Mattress Store	9094-W-MAT-004	PAH	Wipe	Phenanthrene	90	µg/m^2

* Estimated Concentration (J)

Table 8.0 contains the PAH analytical results that were identified as being above the detection limit. These values cannot be directly compared to the health-based benchmark, which is based on the TEF calculations. The TEF values are listed in the tables in Attachment J.

At times during the project, the laboratory chose to perform analyses on samples that were neither requested by EPA nor specified on the Chain of Custody. This was most evident in the case of wipe samples that were collected for total dust. The QAPP required the collection of one pre-cleaning and one post-cleaning sample for total dust from each unit. These samples (wipes) also served as the samples used for the analysis of crystalline silica (alpha-quartz, cristobalite, tridymite, calcite and gypsum). The crystalline silica sample was also collected pre-cleaning and post-cleaning; however, it was collected from three locations in the unit. Upon submitting the samples to the laboratory, specific direction was provided to the lab regarding which samples were to be analyzed for total dust. The laboratory however, chose to prepare all three samples for the total dust analysis rather than prepare the samples specified on the chain of custody.

A mercury vapor investigation was conducted as part of the study. The mercury vapor investigation was conducted using a Lumex® analyzer[18] that revealed a mean mercury vapor concentration of 53.6 ng/m^3 (range 3 - 210 ng/m^3), demonstrating that air samples within the building tested below EPA's Reference Concentration of 300 ng/m^3. A statistical evaluation of the results of the mercury vapor investigation is presented in Attachment K, *Summary of Mercury Vapor Results using the Lumex® Vapor Analyzer*.

(Note: The following section does not include data and discussion of wipe sampling results for alpha-quartz, calcite, gypsum, cristobalite, tridymite and total dust. The analytical results for these parameters were uncertain thereby rendering these data unusable.)

Discussion of Analytical Results by Building Area

Unit 2A – This unit is located on the second floor. It is a 1,335 sq. ft. loft with one bedroom facing Cedar Street. The unit has hardwood floors. The unit presented minimal dust accumulation in the dwelling with the exception of the baseboard-heating units. The windows were not blown in. All personal items were disposed except for a couch and chairs.

Cleaning Method – The unit was cleaned using Test 1B: use of a Ridgid® shop vacuum and Hoover® upright vacuum for vacuuming the floors and other surfaces. Neither vacuum was equipped with a HEPA filter. An AFD was used during the cleaning process. In addition, all horizontal surfaces were wet wiped. This cleaning method was used for each cleaning event.

Cleaning Results – The unit met the primary clearance criteria listed in Table 1.0 for each compound after being cleaned twice.

Asbestos

Before Cleaning Samples – Pre-cleaning micro vacuum and wipe samples were collected for asbestos. These samples indicate that asbestos was present in the unit prior to cleaning. Three of the four micro vacuum samples detected chrysotile. All five wipe samples detected chrysotile, although two of the samples were below the detection limit.

[18]The instrument has a detection limit of 2 ng/m^3.

Post 1st Cleaning Samples – Three air, three micro vacuum, and five wipe samples were collected. The three air samples were analyzed using PCM, TEM AHERA, and PCMe. The PCM results were all below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA and PCMe analysis could not be conducted due to overloading of particulate material.

The results for the three micro vacuum samples indicate that asbestos was present at levels generally lower than those observed before cleaning. One of the samples was identified as non-detect, although asbestos was detected below the detection limit.

The results for the five wipe samples that were collected indicate that asbestos was present in two of the five samples at lower concentrations than the pre-cleaning samples. One of the two samples in which asbestos was detected was below the detection limit.

Post 2nd Cleaning Samples – Six asbestos air samples were collected after the second cleaning. The samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results were all below the secondary numeric criterion of 0.01 f/cc and were at lower concentrations than after the first cleaning. The TEM AHERA results were all below the secondary numeric criterion of 0.022 S/cc; two of the six samples were below the detection limit. The PCMe results were at or below the primary clearance criterion of 0.0009 S/cc; three of the six samples were below the detection limit.

Dioxin

Before Cleaning Samples – Four pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected and analyzed for dioxin. The concentrations of dioxin detected were lower than those of the pre-cleaning samples. The TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Gypsum

Before Cleaning Samples – Pre-cleaning samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected in any sample. Because gypsum was below the detection limit in all of the samples collected, no additional samples were collected for analysis of gypsum.

Lead

Before Cleaning Samples – Four micro vacuum samples and four wipe samples were collected. Lead was detected in three of the four micro vacuum samples at concentrations below the comparison value of 25 µg/ft^2 one sample was below the detection limit. Three of the four wipe samples had detectable concentrations of lead above the primary clearance criterion of 25 µg/ft^2, while the fourth sample was below the detection limit.

Post 1st Cleaning Samples – Two air samples, three micro vacuum samples and four wipe samples were collected after the first cleaning. The two air samples, all three micro vacuum samples, and three of the four wipe samples were below the detection limit. The fourth wipe sample was above detection limit but below the primary clearance criterion. The results from the first cleaning indicate that the cleaning technique was effective in removing the elevated concentrations of lead observed prior to the first cleaning. Because the primary clearance criterion for lead was met after the first cleaning, no additional samples were collected for analysis of lead.

Alpha-Quartz
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. This indicates that the cleaning method used was able to reduce the pre-cleaning concentration of alpha-quartz. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of alpha-quartz.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of calcite.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limits after the first cleaning, no additional samples were collected for analysis of cristobalite.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limits after the first cleaning, no additional samples were collected for analysis of tridymite.

MMVF
Before Cleaning Samples – Four pre-cleaning wipe samples were collected. One of the four samples was below the detection limit; MMVF was detected in the other three samples.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. The results for the air samples indicate that MMVF was present; however, the samples were below the primary clearance criterion of 10 S/L. The results of the five wipe samples indicate that MMVF was still present after the first cleaning; however, the concentrations detected were lower than the pre-cleaning samples. There is not a clearance criterion for MMVF in settled dust. Since the air samples were below the primary clearance criterion and the MMVF in settled dust was reduced after the first cleaning, no additional samples were collected for analysis of MMVF.

PAH

Before Cleaning Samples – Four pre-cleaning wipe samples were collected. Three of the four samples were below the detection limit; the TEF for these samples was below the primary clearance criterion. PAH compounds were detected in the fourth sample; however, the calculated TEF was below the primary clearance criterion of 300 $\mu g/m^2$.

Post 1st Cleaning Samples – Four wipe samples were collected after the first cleaning. All of the samples were below the detection limit and the TEF for each sample was below the primary clearance criterion of 300 $\mu g/m^2$. Because all of the samples were below the detection limit and the primary clearance criterion after the first cleaning, no additional samples were collected for analysis of PAH.

Unit 2B – This unit is located on the second floor. It is a 946 sq. ft. loft with two separate bedrooms facing Cedar Street. The unit has hardwood floors and no carpeting. The unit presented minimal dust accumulation, except around baseboard-heating elements. All windows were intact. All personal items except a couch were disposed of prior to cleanup.

Cleaning Method – The unit was cleaned using Test 3A: an industrial HEPA-filtered vacuum. An AFD was not used. All horizontal surfaces were wet wiped.

Cleaning Results – The unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned once.

Asbestos

Before Cleaning Samples – Three micro vacuum and four wipe samples were collected for analysis of asbestos. These samples indicate that asbestos was present in the unit prior to cleaning. Chrysotile was detected in all three micro vacuum samples. Three of the four wipe samples detected chrysotile. One of the three samples also contained Anthophyllite. However, the result for this sample, as well as for the fourth wipe sample, was below the detection limit.

Post 1st Cleaning – Test 1B – Three air, four micro vacuum, and five wipe samples were collected. Three air samples were analyzed using PCM, TEM AHERA, and PCMe. The PCM results were all below the secondary numeric criterion of 0.01 f/cc. All three TEM AHERA results were below the secondary numeric criterion of 0.022 S/cc. Likewise, all three PCMe results were below the primary clearance criterion of 0.0009 S/cc. The results for four micro vacuum samples indicate that asbestos was present at levels similar to, and in some cases higher than, those observed before cleaning. The results for the five

wipe samples indicate that asbestos was present in three of the five samples. Two of the three samples in which asbestos was detected were below the detection limit.

Dioxin

Before Cleaning Samples – Three pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected in either sample.

Lead

Before Cleaning Samples – Three micro vacuum samples and three wipe samples were collected. Lead was detected in one of the three micro vacuum samples at a concentration below the comparison value of 25 µg/ft^2. Two of the three wipe samples had detectable concentrations of lead; one sample was above the primary clearance criterion of 25 µg/ft^2. The third sample was below the detection limit.

Post 1st Cleaning Samples – Two air samples, four micro vacuum samples and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion. The four micro vacuum samples and one of the four wipe samples, were below the detection limit. Three of the four wipe samples were above the detection limit, but below the primary clearance criterion of 25 µg/ft^2. The results from the first cleaning indicate that the cleaning technique was effective in removing the elevated concentrations of lead that were observed prior to the first cleaning.

Post 2nd Cleaning Sampling – Because the cleaning was conducted prior to the establishment of a risk-based cleanup level for lead in air, this unit was re-cleaned in an effort to meet the established primary clearance criterion. Sampling results following the second cleaning indicate levels below the primary clearance criterion.

Alpha-Quartz

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Calcite

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of calcite.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples and four wipe samples were collected after the first cleaning. All of the samples were below the detection limit.

MMVF
Before Cleaning Samples – Three pre-cleaning wipe samples collected. MMVF was detected in all three.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. The results for the three air samples indicate that MMVF was present; however, all samples were below the primary clearance criterion of 10 S/L. The results of the five wipe samples indicate that MMVF remained present in four of the five samples after the first cleaning, but the concentrations detected were lower than the pre-cleaning samples. There is not a clearance criterion for MMVF in settled dust. Because the air samples were substantially below the primary clearance criterion and the MMVF in settled dust was reduced after the first cleaning, no additional samples were collected for analysis of MMVF.

PAH
Before Cleaning Samples – Three pre-cleaning wipe samples were collected. All three samples were below the detection limit. The TEF for each sample was below the primary clearance criterion.

Post 1st Cleaning Samples – Four wipe samples were collected after the first cleaning. All of the samples were below the detection limit. The TEF for each sample was below the primary clearance criterion of 300 $\mu g/m^2$. Since all of the samples were below the detection limit and the primary clearance criterion after the first cleaning, no additional samples were collected for analysis of PAH.

Second Floor Hallway – The second floor hallway has vinyl tiles on the floor, and walls made of sheet rock covered with wallpaper glue. The ceiling is also made of sheet rock, and is painted.

Cleaning Method – This area was cleaned using Test 4A and Test 4B. Test 4A used an industrial

HEPA filtered vacuum and an AFD. Test 4B was a soap and water wet wipe of the ceiling and floor only.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned once.

Asbestos
Before Cleaning Samples – There were no pre-cleaning samples collected.

Post 1st Cleaning Samples – Two post-cleaning air samples were collected. The two air samples were analyzed using PCM, TEM AHERA, and PCMe. The PCM results were all below the secondary numeric criterion of 0.01 f/cc. Similarly, the TEM AHERA results were all below the secondary numeric criterion of 0.022 S/cc. The PCMe results were all below the primary clearance criterion of 0.0009 S/cc with one of the two samples being below the detection limit.

Dioxin
Before Cleaning Samples – There were no pre-cleaning samples collected.

Post 1st Cleaning Samples – There were no post-cleaning samples collected

Gypsum
Before Cleaning Samples – There were no pre-cleaning samples collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected in any sample.

Lead
Before Cleaning Samples – There were no pre-cleaning samples collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. The two air samples were below the detection limit.

Alpha-Quartz
Before Cleaning Samples – There were no pre-cleaning samples collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Calcite
Before Cleaning Samples – There were no pre-cleaning samples collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

Cristobalite
Before Cleaning Samples – There were no pre-cleaning samples collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

Tridymite
Before Cleaning Samples – There were no pre-cleaning samples collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

MMVF
Before Cleaning Samples – There were no pre-cleaning samples collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. The results indicate that MMVF was present in one of the samples; however, the concentration was below the primary clearance criterion of 10 S/L. Because the air samples were below the primary clearance criterion, no additional samples were collected for analysis of MMVF.

PAH
Before Cleaning Samples – There were no pre-cleaning samples collected.

Post 1st Cleaning Samples – There were no post-cleaning samples collected.

Unit 3A – This 1,368 sq. ft. loft faces Cedar Street and is utilized as office space for the Baldwin Realty Company. Carpet is present on half of the floor space; the remainder is hardwood floors. The area is furnished with 10-12 wooden desks, files and office equipment. The unit presented minimal dust accumulation in the dwelling. No windows were blown in.

Cleaning Method – This unit was cleaned using Test 2B: a Craftsman® shop vacuum and a Eureka® upright vacuum with HEPA filter. An AFD was used during the cleaning process. All horizontal surfaces were wet wiped.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned once.

Asbestos
Before Cleaning Samples – Four air, four micro vacuum and four wipe samples were collected for asbestos. These samples indicate that asbestos was present in the unit prior to cleaning. All four of the micro vacuum samples detected chrysotile. One of the four wipe samples detected chrysotile. The PCM results for both air samples were below the secondary numeric criterion, and the two PCMe air results were below the primary clearance criterion of 0.0009 S/cc.

Post 1st Cleaning Samples – Three air, four micro vacuum and five wipe samples were collected for asbestos. Three asbestos air samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results indicate that one sample was below the secondary

numeric criterion and the other two could not be analyzed due to particulate overloading of the filter. The TEM AHERA results were below the secondary numeric criterion for two samples. The third sample could not be analyzed due to particulate overloading of the filter. Of the three air samples analyzed using PCMe, one sample could not be analyzed due to overloading of particulate material. The other two samples were below the primary clearance criterion of 0.0009 S/cc.

The results of the four micro vacuum samples indicate that asbestos was present at levels generally lower than those observed before cleaning. One of the samples was identified as non-detect.

The results of the five wipe samples indicate that asbestos was present in all but one sample; however, two of the samples were identified as non-detect. One of the non-detect samples had an elevated detection limit due to the presence of non-asbestos particulate matter.

Dioxin

Before Cleaning Samples – Three pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that the concentrations of dioxin were similar to the pre-cleaning samples. The TEQ concentration for each sample was below the criterion of 4 ng/m^2.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected above the detection limit for either sample.

Lead

Before Cleaning Samples – Four micro vacuum samples and three wipe samples were collected. Lead was not detected in any of the micro vacuum samples. One of the wipe samples was below the detection limit and one wipe sample was below the primary clearance criterion of 25 $\mu g/ft^2$. The third wipe sample exceeded the primary clearance criterion at 38.9 $\mu g/ft^2$.

Post 1st Cleaning Samples – Two air samples, four micro vacuum samples, and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion but were qualified as rejected, due to field blank contamination. The results of the micro vacuum and wipe samples show that, while two of the micro vacuum and two of the wipe samples exceeded the detection limits, all samples met the primary clearance criterion and the comparison values for lead after the first cleaning.

Alpha-Quartz
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All samples were below the detection limit.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All were below the detection limit.

MMVF
Before Cleaning Samples – Two pre-cleaning air samples and three pre-cleaning wipe samples were collected. The two air samples had MMVF detected, but were below the primary clearance criterion. The three wipe samples had MMVF detected in concentrations from 57.23 S/cm^2 to 801.24 S/cm^2.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. All of the air sample results indicate that MMVF was present at levels below the primary clearance criterion of 10 S/L. All of the wipe sample results were below the detection limit of 22.89 S/cm^2. This indicates that the cleaning method was able to reduce the pre-cleaning concentration of MMVF.

PAH
Before Cleaning Samples – Three pre-cleaning wipe samples were collected. All three were below the detection limit. The TEF for each sample was below the primary clearance criterion.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected. All four were below the detection limit. The TEF for each sample was below the primary clearance criterion of 300 μg/m^2.

Unit 3B – This unit is located on the third floor. It is a 968 sq. ft. loft with three bedrooms facing Cedar Street. The unit has hardwood floors. No windows were blown in and the unit presented minimal dust accumulation, with the exception of the baseboard heating units, which contained visible dust. All of the tenant's personal items remained in the unit and were cleaned.

Cleaning Method – This unit was cleaned using the Scope A cleaning procedures: industrial HEPA-filtered vacuum of all surfaces. An AFD was used. All surfaces were wet wiped. This cleaning method was used for each cleaning event in this unit.

Cleaning Results – This unit met the primary clearance criteria listed in Table 1.0 for each compound after being cleaned twice.

Asbestos

Before Cleaning Samples – Two air, three micro vacuum and four wipe samples were collected for asbestos. These samples indicate that asbestos was present in the unit prior to cleaning. The two air samples that were collected were analyzed using PCM and PCMe. One PCM result was below the secondary numeric criterion of 0.01 f/cc. The other PCM result was above the secondary numeric criterion. The PCMe results indicate that both samples were below the detection limit and below the primary clearance criterion of 0.0009 S/cc. Two of the three micro vacuum samples detected chrysotile. The third sample was below the detection limit. Three of the four wipe samples were below the detection limit. The fourth one detected chrysotile at a concentration slightly above the detection limit.

Post 1st Cleaning – Three air, three micro vacuum and five wipe samples were collected to evaluate if additional cleaning events were necessary. The three air samples that were collected indicated that all three PCM results were below the secondary numeric criterion of 0.01 f/cc and that the TEM AHERA and PCMe analyses could not be conducted due to overloading of particulate material. Due to inconclusive PCMe results, a second cleaning was conducted.

The results for the three micro vacuum samples indicate that asbestos was present at levels similar to those observed before cleaning.

The results for the five wipe samples that were collected indicate that asbestos was present in all five of the samples at slightly higher concentrations than the pre-cleaning samples. One of the five samples in which asbestos was detected was below the detection limit.

Post 2nd Cleaning – Three asbestos air samples were collected after the second cleaning. The samples were analyzed for PCM, TEM AHERA, and PCMe. Two of the three PCM results were below the detection limit; all three were below the secondary numeric criterion of 0.01 f/cc. All three TEM AHERA results were below the detection limit and below the secondary numeric criterion of 0.022 S/cc. All three PCMe results were below the detection limit and below the primary clearance criterion of 0.0009 S/cc. All of the air asbestos results after the second cleaning were at lower concentrations than the pre-cleaning samples and the samples collected after the first cleaning. This indicates that the cleaning techniques used were efficient at removing asbestos to levels that were below

detection limits and below the primary clearance and secondary numeric criteria.

Dioxin

Before Cleaning Samples – Four pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that there was dioxin present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that the concentrations of dioxin detected were similar to the pre-cleaning samples and that the TEQ concentrations for each sample were well below the primary clearance criterion of 4 ng/m^2. Because the dioxin samples were below the primary clearance criterion for all of the samples collected, no additional samples were collected for analysis of dioxin.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected in any sample. Because gypsum was below the detection limits for all of the samples collected, no additional samples were collected for analysis of gypsum.

Lead

Before Cleaning Samples – Three micro vacuum samples and four wipe samples were collected. The results indicate that all three micro vacuum samples were below the detection limit and at concentrations below the comparison value of 25 μg/ft^2. Two of the four wipe samples had detectable concentrations of lead; however, they were below the primary clearance criterion of 25 μg/ft^2. The third sample was below the detection limit. The fourth sample was lost at the laboratory and was not analyzed.

Post 1st Cleaning Samples – Two air samples, three micro vacuum samples and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion of 1.0 μg/m^3. All three micro vacuum samples and one of the four wipe samples were below the detection limit. Two wipe samples were below the primary clearance criterion and the fourth wipe sample was above the primary clearance criterion. Due to the one lead sample being above the primary clearance criterion, as well as the asbestos samples that exceeded the primary clearance criterion, this unit was cleaned a second time.

Post 2nd Cleaning Samples – Two lead wipe samples were collected after the second cleaning in the area where the post-first cleaning lead exceedance occurred. One of the samples was received broken at the laboratory and was not analyzed. The other sample was below the detection limit and below the primary clearance criterion. The results from the second cleaning indicate that the cleaning technique was effective in removing the elevated concentration of lead that was observed after the first cleaning.

Alpha-Quartz
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. The two air samples were below the detection limit. Because the samples were below the detection limits after the first cleaning, no additional samples were collected for analysis of alpha-quartz.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of calcite.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of cristobalite.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of tridymite.

MMVF
Before Cleaning Samples – Two pre-cleaning air samples and three pre-cleaning wipe samples were collected. One of the two air samples was above the primary clearance criterion of 10 S/L and the other air sample was above the detection limit. The results for all three of the wipe samples indicate that MMVF was above the detection limit. This indicates that MMVF was present in the unit prior to cleaning.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. The results for the three air samples indicate that MMVF was present; however, all three were below the primary clearance criterion of 10 S/L. The results of the five wipe samples indicate that three of the five samples were below the detection limit and the remaining two samples were at the detection limit. Although MMVF was still present after the first cleaning, the concentrations detected were much lower than the pre-cleaning samples. There is not a clearance criterion for MMVF in settled dust. Because the air samples were below the primary clearance criterion and the MMVF in settled dust

was reduced after the first cleaning, no additional samples were collected for analysis of MMVF.

PAH

Before Cleaning Samples – Four pre-cleaning wipe samples were collected. All four samples were below the detection limit. The TEF for each sample was below the primary clearance criterion.

Post 1st Cleaning Samples – Four wipe samples were collected after the first cleaning. All of the samples were below the detection limit. The TEF for each sample was below the primary clearance criterion of 300 μg/m^2. Because all of the samples were below the detection limit and the primary clearance criterion after the first cleaning, no additional samples were collected for analysis of PAH.

Unit 3C – This unit is located on the third floor. It is a 655 sq. ft. loft with two bedrooms facing the WTC site. The unit has hardwood floors with no carpet. The unit presented significant accumulation of dust in the dwelling. The windows were blown in. The majority of personal items were disposed of prior to cleaning.

Cleaning Method – This unit was cleaned using Test 1A: a Craftsman® shop vacuum and a Eureka® upright vacuum with no HEPA filter. An AFD was not used. This method was used for the first two cleaning events. For the third cleaning event the method was changed to Test 3B: an industrial HEPA filtered vacuum and an AFD. All horizontal and vertical surfaces were wet wiped in conjunction with each method.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned three times.

Asbestos

Before Cleaning Samples – Four micro vacuum and four wipe samples were collected for asbestos. These samples indicate that asbestos was present in the unit prior to cleaning. All four of the micro vacuum samples detected chrysotile. Three of the four wipe samples detected chrysotile; one also detected amosite. The fourth wipe sample was below the detection limit.

Post 1st Cleaning Samples – Three air, four micro vacuum, and five wipe samples were collected for asbestos. The PCM and PCMe analyses could not be conducted due to overloading of particulate matter on the filters.

The results of the four micro vacuum samples indicate that asbestos was present at levels higher than those observed before cleaning.

Two of the five wipe samples were below the detection limit, although one of these samples did detect chrysotile. Results of the remaining three samples were above the detection limit and similar to or lower than the pre-cleaning samples.

Post 2nd Cleaning – Four air samples were collected for asbestos. The samples could not be analyzed due to overloading of particulate matter on the filters. Therefore, a third cleaning was conducted using a more aggressive cleaning method: a commercial HEPA vacuum and an AFD.

Post 3rd Cleaning – Six air samples were collected for asbestos after the third cleaning. The samples were analyzed for PCM, TEM AHERA, and PCMe. The results of the PCM analysis indicate that three of the six samples were below the detection limit. The remaining three samples were above the detection limit but below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that all six samples were below the detection limit. The PCMe results also indicate that all six samples were below the detection limit. This suggests that the cleaning techniques used for the third cleaning were effective at reducing the particulate matter to levels that permitted valid air samples to be collected and analyzed, with the results indicating that all six samples were below the primary clearance criterion of 0.0009 S/cc.

Dioxin

Before Cleaning Samples – Three pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present and that the TEQ concentration for one of the three samples was above the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentrations were below the primary clearance criterion of 4 ng/m^2. This indicates that the cleaning techniques used were effective at reducing the pre-cleaning concentrations of dioxin.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected above the detection limit in the air samples.

Lead

Before Cleaning Samples – Four micro vacuum samples and three wipe samples were collected. Lead was detected in all four micro vacuum samples at concentrations above the comparison value. Two of the three wipe samples detected concentrations above the primary clearance criterion of 25 µg/ft^2. The micro vacuum samples exceeded the comparison value in a range of 39.4 µg/ft^2 to 135 µg/ft^2, and the two wipe samples exceeded the primary clearance criterion at 48.7 µg/ft^2 and 750 µg/ft^2. This indicates that lead was present prior to cleaning.

Post 1st Cleaning Samples – Two air samples, four micro vacuum samples, and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion. The results of the micro vacuum and wipe samples show that all but one micro vacuum sample (26.9 µg/ft^2) met the comparison value or primary clearance criterion for lead.

Post 2nd Cleaning Samples – Two air samples were collected after the second cleaning. Both samples detected concentrations below the primary clearance criterion.

Alpha-Quartz
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All samples were below the detection limit.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of calcite.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Since all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of cristobalite.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Since all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of tridymite.

MMVF
Before Cleaning Samples – Three pre-cleaning wipe samples were collected. The three wipe samples detected MMVF in concentrations from 343.39 S/L to 744.01 S/L. This indicates that MMVF was present prior to cleaning.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. All of the air sample results indicate that MMVF was present at levels below the primary clearance criterion of 10 S/L. All of the wipe sample results were above the detection limit and at concentrations similar or lower than the pre-cleaning samples.

Post 2nd Cleaning – Five air samples were collected after the second cleaning. Four of the five samples were below the primary clearance criterion of 10 S/L. However, one sample exceeded the primary clearance criterion at 91.796 S/L. This value was further evaluated

and determined to be invalid due to an equipment malfunction which resulted in the collection of a volume of air significantly lower than the other four samples. It should be noted that the other four post-2nd cleaning air samples, and the three post-1st cleaning air samples were below the applicable health-based benchmark.

PAH

Before Cleaning Samples – Three pre-cleaning wipe samples were collected. Two of the three samples were below the detection limit. The calculated TEF for these two samples was below the primary clearance criterion. Twelve PAH compounds were detected in the third sample. The calculated TEF for this sample exceeded the TEF of 300 $\mu g/m^2$ with a value of 1,046.6 $\mu g/m^2$.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected. All four samples were below the detection limit. The TEF for each sample was below the primary clearance criterion of 300 $\mu g/m^2$. This indicates that the cleaning techniques used were effective in reducing the PAH pre-cleaning concentrations.

Unit 3D – This unit is located on the third floor. It is a 968 sq. ft. loft with three bedrooms, facing the WTC site. The unit has hardwood floors with no carpet. This unit presented a significant accumulation of dust in the dwelling. Its windows were blown in. The majority of personal items, with the exception of three pieces of hardwood furniture, were disposed of prior to cleaning.

Cleaning Method – This unit was cleaned using Test 1A: a Ridgid® shop vacuum and a Hoover® upright without a HEPA filter. AFDs were not used during cleaning. All horizontal surfaces were wet wiped. This cleaning method was used for each cleaning event.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned twice.

Asbestos

Before Cleaning Samples – Three micro vacuum and five wipe samples were collected for asbestos. These samples indicate that asbestos was present in the unit before cleaning. All three of the micro vacuum samples detected chrysotile, and four of the five wipe samples detected chrysotile. The remaining sample was below the detection limit.

Post 1st Cleaning Samples – Three micro vacuum, five wipe samples and three air samples were collected for asbestos.

All three of the air samples, which were analyzed using PCM, TEM AHERA, and PCMe, could not be analyzed due to overloading of particulate material. Due to this situation, a second cleaning was conducted.

The results of the three micro vacuum samples indicate that asbestos was present at levels lower than those observed before cleaning. One of the samples was below the detection limit.

The results of the five wipe samples indicate that asbestos was present in all of the samples, but generally at lower concentrations than those observed before cleaning.

Post 2nd Cleaning Samples – Four post-cleaning air samples were collected for asbestos. These samples were analyzed using PCM, TEM AHERA, and PCMe. The results of the PCM analysis were below the secondary numeric criterion of 0.01 f/cc. One sample was below the detection limit. The TEM AHERA results were all below the detection limit. The PCMe results were also all below the primary clearance criterion of 0.0009 S/cc. This indicates that the cleaning techniques were effective at reducing the particulate matter, which allowed valid air samples to be collected and analyzed.

Dioxin

Before Cleaning Samples – Four pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2 and were detected at lower concentrations than in the pre-cleaning samples. This indicates that the cleaning techniques were effective in reducing dioxin concentrations.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected above the detection limit of 0.008 mg/m^3 in the air samples.

Lead

Before Cleaning Samples – Three micro vacuum samples and four wipe samples were collected. One of the three micro vacuum samples was above the comparison value. The other two results were below the detection limit. The results indicate lead was present in two of the four wipe samples at concentrations above the primary clearance criterion of 25 $\mu g/ft^2$. The micro vacuum samples exceeded the comparison value at 50.7 $\mu g/ft^2$ and the two wipe samples exceeded the primary clearance criterion at 112 $\mu g/ft^2$ and 201 $\mu g/ft^2$.

Post 1st Cleaning Samples – Two air samples, three micro vacuum samples, and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion but were qualified as rejected due to field blank contamination. The results of the micro vacuum and wipe samples show that while one of the micro vacuum (qualified as rejected) and two of the wipes samples exceeded the detection limit, all samples met the comparison value and the primary clearance criterion for lead after the first cleaning. Therefore, additional samples were not collected for analysis of lead.

Alpha-Quartz

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All samples were below the detection limit.

Calcite

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of calcite.

Cristobalite

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of cristobalite.

Tridymite

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of tridymite.

MMVF

Before Cleaning Samples – Four pre-cleaning wipe samples were collected. The four wipe samples had MMVF detected in concentrations from 228.93 S/cm^2 to 1259.09 S/cm^2. This indicates that MMVF was present prior to cleaning.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. All of the air sample results indicate that MMVF was present but at levels below the primary clearance criterion of 10 S/L. All of the wipe sample results were at or below the detection limit of 22.89 S/cm^2 . This indicates that the cleaning method was able to reduce the pre-cleaning concentration of MMVF.

PAH

Before Cleaning Samples – Four pre-cleaning wipe samples were collected. Three of the four samples were below the detection limit and below the primary clearance criterion. The fourth sample had two PAH compounds detected; the calculated TEF was below the primary clearance criterion.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected. All four samples were below the detection limit, and each sample was below the primary clearance criterion of 300 µg/m^2.

Third Floor Hallway – The third floor hallway is an area with plywood floors, and walls made of sheet rock covered with wallpaper glue. The ceiling is also made of sheet rock, and is painted.

Cleaning Method – This area was cleaned using Test 4A and Test 4B. Test 4A used industrial HEPA-filtered vacuums and an AFD, while Test 4B consisted of a soap and water wet wipe of the ceiling only.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned once.

Asbestos
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two post-cleaning air samples were collected. The two air samples were analyzed using PCM, TEM AHERA, and PCMe. The PCM result were all below the secondary numeric criterion of 0.01 f/cc. Similarly, the TEM AHERA results were all below the secondary numeric criterion of 0.022 S/cc. The PCMe results were all below the primary clearance criterion of 0.0009 S/cc with both samples being below the detection limit.

Dioxin
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – There were no samples collected after cleaning.

Gypsum
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – There were two air samples collected after the first cleaning. Gypsum was not detected in any sample.

Lead
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – There was one air sample collected after the first cleaning. The air sample was below the detection limit. Since the primary clearance criterion was met for lead after the first cleaning, no additional lead samples were collected.

Alpha-Quartz
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – There were two air samples collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of alpha-quartz.

Calcite
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

Cristobalite
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – There were two air samples collected after the first cleaning. Both were below the detection limit.

Tridymite
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

MMVF
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. The results indicate that MMVF was present in both samples; however, the concentrations were below the primary clearance criterion of 10 S/L. Because the air samples were below the primary clearance criterion, no additional samples were collected for MMVF.

PAH
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – There were no samples collected after cleaning.

Unit 4A – This unit is located on the fourth floor. It is a 1,368 sq. ft. open loft facing Cedar Street. No windows were blown in and there was minimal dust accumulation in the dwelling with the exception of the baseboard heating units, which contained visible dust. The unit has hardwood floors. All of the tenant's personal items were removed prior to the cleanup.

Cleaning Method – This unit was cleaned using Test 2A: a Craftsman® shop vacuum and Eureka® upright vacuum with a HEPA filter for vacuuming the floors and other surfaces. There were no AFDs used during the cleaning process. In addition, all horizontal surfaces were wet wiped. This cleaning method was used for each cleaning event.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned twice.

Asbestos
Before Cleaning Samples – Three micro vacuum and four wipe samples were collected

for asbestos. These samples indicate that asbestos was present in the unit prior to cleaning. All three micro vacuum samples detected chrysotile above the detection limit. Three of the four wipe samples were below the detection limit; however, chrysotile was detected in two of these samples. The fourth wipe sample was above the detection limit.

Post 1st Cleaning – Three air samples, three micro vacuum samples, and five wipe samples were collected. The three air samples were analyzed using PCM, TEM AHERA, and PCMe. The PCM, TEM AHERA and PCMe analyses could not be conducted due to overloading of particulate material. Due to inconclusive asbestos air results, a second cleaning was conducted.

The results for the three micro vacuum samples indicate that asbestos was present at levels similar to or higher than those observed before cleaning. One of the samples was identified as non-detect, although asbestos was present below the detection limit.

The results for the five wipe samples that were collected indicate that asbestos was present in all five samples, although two samples were below the detection limit. The concentrations observed were similar to or higher than the pre-cleaning samples.

Post 2nd Cleaning – Three asbestos air samples were collected after the second cleaning. The samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results could not be obtained due to the filter being overloaded with particulate material. The TEM AHERA results for each sample were below the detection limit and below the secondary numeric criterion of 0.022 S/cc. The PCMe results were all below the primary clearance criterion of 0.0009 S/cc, with all three of the samples below the detection limit. This indicates that the cleaning techniques used were able to reduce the particulate matter in the unit after the second cleaning, which permitted samples to be analyzed. The results of the analysis indicated that asbestos concentrations were below the primary clearance criterion of 0.0009 S/cc.

Dioxin

Before Cleaning Samples – Three pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected in any sample.

Post 2nd Cleaning Samples – Two air samples were collected after the second cleaning.

Gypsum was not detected in any sample.

Lead

Before Cleaning Samples – Three micro vacuum samples and three wipe samples were collected. The results indicate that all three of the micro vacuum samples were below the comparison value of 25 $\mu g/ft^2$ and below the detection limit. The three wipe samples contained detectable concentrations of lead; however, all of the concentrations were below the primary clearance criterion of 25 $\mu g/ft^2$.

Post 1st Cleaning Samples – Two air samples, three micro vacuum samples and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion of 1.0 $\mu g/m^3$. Two of the three micro vacuum samples were below the detection limit. The third micro vacuum sample was slightly above the detection limit, but below the comparison value. Three of the four wipe samples were below the detection limit. The fourth sample was above the detection limit but below the primary clearance criterion. Since the primary clearance criterion was met for lead after the first cleaning, no additional samples were collected for analysis of lead.

Alpha-Quartz

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. One of the two air samples detected alpha-quartz at a concentration above the detection limit, at 0.008 mg/m^3. The detection also was above the primary clearance criterion of 0.004 mg/m^3. The other air sample was below the detection limit. Since one air sample exceeded the primary clearance criterion, additional air samples for alpha-quartz were collected.

Post 2nd Cleaning Samples – Two air samples were collected after the second cleaning. The results showed that both samples were below the detection limit. This indicates that the second cleaning was able to reduce the alpha-quartz concentration in air to below the detection limit.

Calcite

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Post 2nd Cleaning Samples – Two air samples were collected after the second cleaning. The results indicate that both samples were below the detection limit.

Cristobalite

Before Cleaning Samples –Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Post 2nd Cleaning Samples – Two air samples were collected after the second cleaning. The results indicate that both samples were below the detection limit.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Post 2nd Cleaning Samples – Two air samples were collected after the second cleaning. The results indicate that both samples were below the detection limit.

MMVF
Before Cleaning Samples – Three pre-cleaning wipe samples were collected. All three sample results indicate that MMVF was present above the detection limit.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. The results for the three air samples indicate that MMVF was present; however, both samples were below the primary clearance criterion of 10 S/L. The results of the five wipe samples indicate that four of the samples were below the detection limit and one sample was at the detection limit. The MMVF concentrations after the first cleaning were lower than those in the pre-cleaning samples. There is not a clearance criterion for MMVF in settled dust. Since the air samples were below the primary clearance criterion and the MMVF in settled dust was greatly reduced after the first cleaning, no additional samples were collected for analysis of MMVF.

PAH
Before Cleaning Samples – Three pre-cleaning wipe samples were collected. All three samples were below the detection limit and the TEF for each sample was below the primary clearance criterion.

Post 1st Cleaning Samples – Four wipe samples were collected after the first cleaning. All of the samples were below the detection limit. The TEF for each sample was below the primary clearance criterion of 300 $\mu g/m^2$. Since all of the samples were below the detection limit and the primary clearance criterion after the first cleaning, no additional samples were collected for analysis of PAH.

Unit 4B – This unit is located on the fourth floor. It is a 968 sq. ft. loft with four bedrooms facing Cedar Street. No windows were blown in and there was minimal dust accumulation in the dwelling with the exception of the baseboard heating units, which contained visible dust. The unit has hardwood floors and all of the tenant's personal items were cleaned and sealed in bags prior to the cleanup.

Cleaning Method – This unit was cleaned using Test 2B. a Ridgid® shop vacuum and Hoover® upright vacuum with a HEPA filter for vacuuming the floors and other surfaces. An AFD was used during the cleaning process. In addition, all horizontal surfaces were wet wiped. This

cleaning method was used for each cleaning event.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned once.

Asbestos

Before Cleaning Samples – Pre-cleaning wipe samples were collected for asbestos. The results for these samples indicate that asbestos was present in the unit prior to cleaning. Two of the five wipe samples were below the detection limit, although one of these samples had chrysotile detected. The remaining three samples had chrysotile detected above the detection limit.

Post 1st Cleaning – Three air and five wipe samples were collected. The three air samples were analyzed using PCM and PCMe. The PCM results were all below the secondary numeric criterion of 0.01 f/cc. The PCMe results for each sample were below the primary clearance criterion of 0.0009 S/cc and were reported as below the detection limit.

The results for the five wipe samples that were collected indicate that asbestos was present in two of the five samples; however one of these samples was below the detection limit. The remaining three samples were below the detection limit.

Dioxin

Before Cleaning Samples – Four pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that there was dioxin present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected in any sample.

Lead

Before Cleaning Samples – Four pre-cleaning wipe samples were collected. The results indicate that lead was detected in three of the four wipe samples with two samples exceeding the primary clearance criterion of 25 $\mu g/ft^2$. One sample was slightly over the primary clearance criterion with a result of 30 $\mu g/ft^2$, while the second was twice the primary clearance criterion with a result of 50 $\mu g/ft^2$.

Post 1st Cleaning Samples – Two air samples and four wipe samples were collected after the first cleaning. The two air samples were above the detection limit but below the primary clearance criterion of 1.0 $\mu g/m^3$. Three of the four wipe samples were below the detection limit. The fourth wipe sample was above the detection limit but below the

primary clearance criterion. Since the primary clearance criterion was met for lead after the first cleaning, no additional cleaning was necessary.

Post 2nd Cleaning Sampling – Because the cleaning was conducted prior to the establishment of a risk based cleanup level for lead in air, this unit was re-cleaned in an effort to meet the initially established clearance criterion . Sampling results following the second cleaning indicated levels below the primary clearance criterion.

Alpha-Quartz
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

MMVF
Before Cleaning Samples – Four pre-cleaning wipe samples collected. All four samples had MMVF detected above the detection limit.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. The results for the three air samples indicate that MMVF was present; however, both samples were below the primary clearance criterion of 10 S/L. The results of the five wipe samples indicate that MMVF was still present after the first cleaning; however, the concentrations detected were generally lower than the pre-cleaning samples. There is not a clearance criterion for MMVF in settled dust.

PAH
Before Cleaning Samples – Four pre-cleaning wipe samples were collected. All four samples were below the detection limit and the TEF for each sample was below the primary clearance criterion.

Post 1st Cleaning Samples – Four wipe samples were collected after the first cleaning. All of the samples were below the detection limit and the TEF for each sample was below the primary clearance criterion of 300 μg/m^2. Because all of the samples were below the detection limit and the primary clearance criterion after the first cleaning, no additional samples were collected for analysis of PAH.

Unit 4C – This unit is located on the fourth floor. It is a 655 sq. ft. open loft that faces the WTC site. The windows were blown in and there was significant dust accumulation in the dwelling. The unit has hardwood floors and no carpet. All personal possessions to be retained by the tenant were vacuumed and bagged.

Cleaning Method – This unit was cleaned using Test 1A: a Craftsman® shop vacuum and a Eureka® upright vacuum for vacuuming the floors and other surfaces. No HEPA or AFD was used during the cleaning process. In addition, all horizontal surfaces were wet wiped.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned once.

Supplemental Sampling Activities – The air samples collected for PAH analysis were taken for reference purposes only. These samples are discussed in the PAH section below.

Asbestos

Before Cleaning Samples – Pre-cleaning micro vacuum and wipe samples were collected for asbestos. These samples indicate that asbestos was present in the unit prior to cleaning. All four of the micro vacuum samples detected chrysotile, and one of the four micro vacuum samples detected amosite. Three of the four wipe samples detected chrysotile; however, one of these samples was below the detection limit. The fourth wipe sample did not detect chrysotile and was below the detection limit.

Post 1st Cleaning Samples – Three air samples, three micro vacuum samples, and five wipe samples were collected for asbestos. The samples were analyzed using PCM, TEM AHERA, and PCMe. The PCM analysis could not be conducted due to overloading of particulate material. The TEM AHERA results were above the detection limit but were below the secondary numeric criterion of 0.022 S/cc. Two of the three air samples analyzed using PCMe were below the primary clearance criterion of 0.0009 S/cc. The third air sample detected chrysotile and was present at the primary clearance criterion of 0.0009 S/cc. Since the primary primary clearance criterion was met, no additional cleaning was required.

The results of the three micro vacuum samples indicate that asbestos was present at levels lower than those observed before cleaning.

The results of the five wipe samples indicate that asbestos was present above the detection level in one of the five samples. The concentrations were lower than in the pre-cleaning concentrations.

Dioxin

Before Cleaning Samples – Three pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that there was dioxin present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that the TEQ concentration for each sample was below the criterion of 4 ng/m^2 and were detected at lower concentrations than in the pre-cleaning samples.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected above the detection limit in these samples.

Lead

Before Cleaning Samples – Four micro vacuum samples and three wipe samples were collected. The results indicate that all four micro vacuum samples exceeded the comparison value. Two of the three wipe samples exceeded the primary clearance criterion of 25 μg/ft^2. The third wipe sample was below the detection limit. The micro vacuum samples ranged in concentration from 69.8 μg/ft^2 to 83.7 μg/ft^2, and the wipe samples ranged from non-detect to 181 μg/ft^2.

Post 1st Cleaning Samples – Two air samples, three micro vacuum samples, and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion of 1.0 μg/m^3. The results of the micro vacuum and wipe samples show that all samples met the comparison value or primary clearance criterion for lead after the first cleaning; however, three of the four wipe samples were qualified as rejected due to field blank contamination, and one wipe sample was not analyzed because it was not received at the laboratory.

Post 2nd Cleaning Samples – While the study was underway, there was a revision from a background clearance criterion for lead in air of 0.1 μg/m^3 to a health-based clearance criterion for lead in air of 1.0 μg/m^3. The initial results were compared to the background clearance criterion which resulted in a decision to re-clean the dwelling and resample for lead in air. This also occurred in four other units and although these units were cleaned a second time and samples were collected after the second cleaning, the revised lead-in-air criterion actually negated the need for the second cleaning and sampling events. One air sample was collected and analyzed for lead. The result for this sample indicates that the concentration was below the primary clearance criterion of 1.0 μg/m^3.

Alpha-Quartz

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

MMVF
Before Cleaning Samples – Three pre-cleaning wipe samples were collected. The three wipe samples contained MMVF detected at concentrations from 57.23 S/cm^2 to 1030.17 S/cm^2. This indicates that MMVF was present prior to cleaning.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. All of the air sample results indicate that MMVF was present, but at concentrations below the primary clearance criterion of 10 S/L. The wipe sample results were detected in concentrations ranging from 57.23 S/cm^2 to 343.39 S/cm^2 which were similar to or lower than the pre-cleaning samples.

PAH
Before Cleaning Samples – Three pre-cleaning wipe samples were collected. Two of the three samples were below the detection limit; the TEF for each sample was below the primary clearance criterion. PAH compound was detected in the third sample; however the calculated TEF was below the primary clearance criterion of 300 µg/m^2.

Post 1st Cleaning Samples – Two post-cleaning air samples and four post-cleaning wipe samples were collected. Both air samples had seven PAH compounds detected; however, the calculated TEFs for these samples were below the primary clearance criterion of 0.2 µg/m^3. All wipe samples were below the detection limit and the TEF for each sample was below the primary clearance criterion of 300 µg/m^2.

Unit 4D – This unit is on the fourth floor. It is a 968 sq. ft. open loft facing the WTC site. The unit had windows blown in and presented a significant accumulation of dust. The dwelling has hardwood floors with no carpet. All personal possessions to be retained by the tenant were vacuumed and bagged.

Cleaning Method – This unit was cleaned using Test 2A: a Ridgid® shop vacuum and a Eureka® upright vacuum with a HEPA filter. No AFDs were used. All horizontal surfaces were wet-wiped. This cleaning method was used for each cleaning event.

Cleaning Results – This unit met the clearance listed in Table 1.0 for each compound after being cleaned twice.

Asbestos

Before Cleaning Samples – Six micro vacuum and five wipe samples were collected for asbestos. These samples indicate that asbestos was present in the unit prior to cleaning. All six of the micro vacuum samples detected chrysotile above the detection limit. Two of the five wipe samples were below the detection limit, although one detected chrysotile. The remaining three samples were above the detection limit.

Post 1st Cleaning Samples – Three air, six micro vacuum samples and five wipe samples were collected for asbestos. The samples were analyzed using PCM, TEM AHERA, and PCMe. The results for the PCM analysis indicate that two of the three samples were below the secondary numeric criterion of 0.01 f/cc. The third slightly exceeded this value with a concentration of 0.02 f/cc. The TEM AHERA results indicate that all three samples were below the secondary numeric criterion of 0.022 S/cc. The PCMe results indicate that two of the three air samples were below the primary clearance criterion of 0.0009 S/cc. The third sample detected chrysotile and was at the primary clearance criterion of 0.0009 S/cc.

The results of the six micro vacuum samples indicate that asbestos was present at levels lower than those observed before cleaning.

The results of the five wipe samples indicate that asbestos was present in all of the samples at concentrations similar to or lower than those observed before cleaning.

Dioxin

Before Cleaning Samples – Four pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that there was dioxin present at concentrations lower than those observed in the pre-cleaning samples. In addition, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2. This indicates that the cleaning techniques were effective at reducing dioxin concentrations.

Gypsum

Before Cleaning Samples - Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples - Two air samples were collected after the first cleaning. Gypsum was not detected above the detection limit of 0.016 mg/m^3 for these samples.

Lead
Before Cleaning Samples – Six micro vacuum samples and four wipe samples were collected. The results indicate that lead was detected in all six of the micro vacuum samples at concentrations above the comparison value of 25 μg/ft^2, ranging from 26.2 μg/ft^2 to 83.5 μg/ft^2. One of the four wipe samples exceeded the primary clearance criterion of 25 μg/ft^2 with a concentration of 169 μg/ft^2.

Post 1st Cleaning Samples – Two air samples, six micro vacuum samples, and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion but were qualified as rejected due to lab blank contamination. The results of the micro vacuum and wipe samples show that all but one wipe sample (66 μg/ft^2) met the comparison value or primary clearance criterion for lead.

Post 2nd Cleaning Samples – One air sample and one wipe sample were collected after the second cleaning. Both sample results were below their respective clearance criterion.

Alpha-Quartz
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All samples were below the detection limit.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Since all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of calcite.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of cristobalite.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit. Because all of the samples were below the detection limit after the first cleaning, no additional samples were collected for analysis of tridymite.

MMVF

Before Cleaning Samples – Four wipe samples were collected. MMVF was detected in the wipe samples in concentrations from 286.16 S/cm^2 to 2174.79 S/cm^2.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. All of the air sample results indicate that MMVF was present, but at levels below the primary clearance criterion of 10 S/L. All of the wipe sample results were in the range of 57.23 S/cm^2 to 572.31 S/cm^2, which is lower than the pre-cleaning range. This indicates that the cleaning techniques were effective at reducing MMVF concentrations.

PAH

Before Cleaning Samples – Four wipe samples were collected. Three of the four samples were below the detection limit with TEF values below the primary clearance criterion. The fourth sample had six PAH compounds detected; the calculated TEF slightly exceeded the primary clearance criterion of 300 μg/m^2 with a value of 325.8 μg/m^2.

Post 1st Cleaning Samples – Four wipe samples were collected. All four samples were below the detection limit, and the TEF for each sample was below the primary clearance criterion of 300 μg/m^3.

Fourth Floor Hallway – The fourth floor hallway is an area with plywood floors and walls made of sheet rock covered with wallpaper glue. The ceiling is also made of sheet rock, and is painted.

Cleaning Method – This area was cleaned using Test 4A and Test 4B. Test 4A used an industrial HEPA-filtered vacuum and an AFD, while Test 4B consisted of a soap and water wet wipe of only the ceiling.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned once.

Asbestos

Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One sample was collected after cleaning. The air sample was analyzed using PCM, TEM AHERA, and PCMe. The PCM result was below the secondary numeric criterion of 0.01 f/cc. Similarly, the TEM AHERA result was below the secondary numeric criterion of 0.022 S/cc. The PCMe result was below the primary clearance criterion of 0.0009 S/cc with the sample being below the detection limit.

Dioxin

Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – There were no post- cleaning samples collected.

Gypsum
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. Gypsum was not detected.

Lead
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. The air sample was below the primary clearance criterion of 1.0 $\mu g/m^3$.

Alpha-Quartz
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. The sample was below the detection limit.

Calcite
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. The sample was below the detection limit.

Cristobalite
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. The sample was below the detection limit.

Tridymite
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. The sample was below the detection limit.

MMVF
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. The results indicate that MMVF was present in the sample; however, the concentration was below the primary clearance criterion of 10 S/L.

PAH
Before Cleaning Samples – There were no samples collected.

Post 1st Cleaning Samples – There were no samples collected.

Unit 5A – This unit is on the fifth floor. It is a 1,404 sq. ft. loft facing Cedar Street with one bedroom. The unit has hardwood floors and no carpet. One window had been blown in. The dwelling presented minimal accumulation of dust, except for baseboard-heating units. Numerous items were cleaned, then bagged.

Cleaning Method – This unit was cleaned using Test 3B: an Industrial HEPA-filtered vacuum. An AFD was used during cleaning. In addition, all horizontal surfaces were wet wiped.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned twice.

Asbestos

Before Cleaning Samples – Seven micro vacuum and four wipe samples were collected for analysis of asbestos. These samples indicate that asbestos was present in the unit prior to cleaning. Chrysotile was detected in six of the seven micro vacuum samples and all four of the wipe samples; however, chrysotile was present below the detection limit in two of the four wipe samples.

Post 1st Cleaning – Three air samples, seven micro vacuum samples, and five wipe samples were collected. The three air samples were analyzed using PCM and PCMe. The PCM results were all below the secondary numeric criterion of 0.01 f/cc. All three PCMe analyses were at or below the primary criterion of 0.0009 S/cc.

The results for the seven micro vacuum samples indicate that asbestos results varied and were present at levels higher and lower than before cleaning.

The results for the five wipe samples showed that asbestos was present in one sample; however, all samples were below the detection limit. The results indicate that the cleaning techniques used were effective in reducing the asbestos concentrations observed prior to cleaning.

Dioxin

Before Cleaning Samples – Three wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four wipe samples were collected and analyzed for dioxin. The results indicate that the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected in any sample.

Lead
Before Cleaning Samples – Seven micro vacuum samples and three wipe samples were collected. Lead was detected in one of the seven micro vacuum samples at concentrations below the comparison value of 25 μg/ft^2. All three wipe samples had detectable concentrations of lead, two of which were above the primary clearance criterion of 25 μg/ft^2.

Post 1st Cleaning Samples – Two air samples, seven micro vacuum samples and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion of 1.0 μg/m^3. All seven micro vacuum samples were below the comparison value. Two of the four wipe samples exceeded the primary clearance criterion, therefore, additional cleaning was necessary.

Post 2nd Cleaning Sampling – Three wipe samples were collected following the second cleaning. The results of all three samples were below the primary clearance criterion. In two of the samples, lead was not detected. The sampling results following the second cleaning indicate that the primary clearance criterion was met.

Alpha-Quartz
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. All of the samples were below the detection limit.

MMVF
Before Cleaning Samples – Three pre-cleaning wipe samples were collected. MMVF was detected in all three of the samples.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. The results of the three air samples indicate that MMVF was present; however, all samples were below the primary clearance criterion of 10 S/L. The results of the five wipe samples indicate that MMVF continued to be present in all of five of the samples after the first cleaning; however, the concentrations detected were lower than in the pre-cleaning samples. This indicates that the cleaning techniques were effective at reducing the pre-cleaning concentrations of MMVF.

PAH

Before Cleaning Samples – Three pre-cleaning wipe samples were collected. All three samples were below the detection limit. The TEF for each sample was below the primary clearance criterion.

Post 1st Cleaning Samples – Four wipe samples were collected after the first cleaning. All were below the detection limit and the TEF for each sample was below the primary clearance criterion of 300 $\mu g/m^2$. Since all of the samples were below the detection limit and the primary clearance criterion after the first cleaning, no additional samples were collected for analysis of PAH.

Unit 5C – This unit is located on the fifth floor. It is a 968 sq. ft. loft with three separate bedrooms facing the WTC. The unit has hardwood floors. Windows were blown in. There was significant accumulation of dust in the dwelling. All of the tenant's personal items were removed prior to cleaning.

Cleaning Method – This unit was cleaned twice using Test 3A: an industrial HEPA-filtered vacuum for vacuuming the floors and other surfaces. An AFD was not used during the cleaning process. All horizontal surfaces were wet wiped. This cleaning method was used for the first two cleaning events. The third cleaning event used Test 3B, which is similar to Test 3A described above; however, AFDs were used during the third cleaning.

Cleaning Results – With the exception of asbestos, this unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned three times.

Asbestos

Before Cleaning Samples – Three micro vacuum and four wipe samples were collected for analysis of asbestos. These samples indicate that asbestos was present in the unit prior to cleaning. All three micro vacuum samples, as well as all four wipe samples, detected chrysotile above the detection limit.

Post 1st Cleaning – Three air samples, three micro vacuum samples, and five wipe samples were collected. The three air samples were analyzed using PCM and PCMe. The PCM results indicate that two of the samples were below the secondary numeric criterion of 0.01 f/cc. The third slightly exceeded the primary clearance criterion with a result of 0.015 f/cc. The PCMe analysis could not be conducted due to overloading of particulate material. Due to inconclusive PCMe results, a second cleaning was conducted.

The results for two of the three micro vacuum samples indicate that asbestos was present at levels similar to those observed before cleaning. The third micro vacuum sample was reported as being below the detection limit.

The results for the five wipe samples indicate that two of the five samples were below the detection limit, although one of these samples had chrysotile detected. The remaining three samples had chrysotile detected at concentrations above the detection limit. Unlike the micro vacuum samples, the results of the wipe samples collected after the first cleaning were lower than the pre-cleaning concentrations. This indicates that the cleaning techniques used were able to reduce the concentrations of asbestos in settled dust.

Post 2nd Cleaning – Five asbestos air samples were collected after the second cleaning. The samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM, TEM AHERA, and PCMe results could not be obtained due to the filters being overloaded with particulate material. Due to inconclusive PCMe results, a third cleaning was conducted.

Post 3rd Cleaning – Four asbestos air samples were collected after the third cleaning. The samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results indicate that one sample was below the detection limit and the other three were at the detection limit. All PCM results were below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results had chrysotile detected above the detection limit; however, all four results were below the secondary numeric criterion of 0.022 S/cc. The PCMe results indicate that two of the samples which were collected under a modified-aggressive sampling methodology, were below or at the detection limit. The remaining two samples, collected under an aggressive sampling methodology, were slightly above the primary clearance criterion of 0.0009 S/cc with results of 0.0015 S/cc and 0.0016 S/cc. The results obtained from the samples collected with the modified-aggressive sampling were used as evidence of meeting the primary clearance criterion.

Dioxin

Before Cleaning Samples – Three pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2. Since dioxin was below the detection limit for all of the samples collected, there were no additional dioxin samples collected.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Gypsum was not detected in any sample.

Lead

Before Cleaning Samples – Three micro vacuum samples and three wipe samples were

collected. Lead was detected in all three micro vacuum samples at concentrations above (approximately four to six times) the comparison value of 25 μg/ft^2. Two of the three wipe samples had detectable concentrations of lead above the primary clearance criterion of 25 μg/ft^2, while the third was below the primary clearance criterion.

Post 1st Cleaning Samples – Two air samples, three micro vacuum samples and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion of 1.0 μg/m^3. However, at the time the results were received, the primary clearance criterion that was being used for comparison was the background clearance criterion of 0.1 μg/m^3, not the health-based clearance criterion of 1.0 μg/m^3 which was developed during the execution of this project. Therefore, additional air samples were collected after the second cleaning.

All three micro vacuum samples were below the detection limit. This indicates that the cleaning techniques used were able to reduce the elevated pre-cleaning lead concentrations that were observed in the settled dust in the areas where the samples were collected.

The results of three of the four wipe samples were below the primary clearance criterion (one sample was broken and not analyzed). The results from the first cleaning indicate that the cleaning technique was effective in removing the elevated concentrations of lead that were observed prior to the first cleaning. Since the primary clearance criterion was met for lead after the first cleaning, no additional samples were collected for the analysis of lead, with the exception of the air samples discussed above.

Post 2nd Cleaning – Two air samples were collected after the second cleaning. The results of both indicate that the samples were below the primary clearance criterion of 1.0 μg/m^3. Since the primary clearance criterion was met for lead after the first cleaning, no additional samples were collected.

Alpha-Quartz
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both samples were below the detection limit.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both samples were below the detection limit.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. One was below the detection limit and one was slightly above the detection limit.

MMVF
Before Cleaning Samples – Three pre-cleaning wipe samples were collected. All three samples were above the detection limit.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. The results indicate that MMVF was present in all three, with two samples being above the primary clearance criterion of 10 S/L. The third was below the primary clearance criterion. The results of the five wipe samples indicate that MMVF was still present after the first cleaning at concentrations similar to or higher than the pre-cleaning samples. There is not a clearance criterion for MMVF in settled dust; however, since two of the air samples were above the primary clearance criterion, additional air samples were collected for analysis of MMVF.

Post 2nd Cleaning – Five air samples were collected after the third cleaning. The results indicate that the two of the five samples were above the primary clearance criterion. Due to this situation, additional air samples were collected after the third cleaning.

Post 3rd Cleaning – Two air samples were collected after the second cleaning. The results indicate that both samples were below the primary clearance criterion and below the detection limit.

PAH
Before Cleaning Samples – Three pre-cleaning wipe samples were collected. Two of the three samples were below the detection limit; the TEF for these samples was below the primary clearance criterion. The third sample had four PAH compounds detected; the calculated TEF was 303.5 $\mu g/m^2$**,** which is slightly above the primary clearance criterion of 300 $\mu g/m^2$.

Post 1st Cleaning Samples – Four wipe samples were collected after the first cleaning. All were below the detection limit. The TEF for each sample was below the primary clearance criterion of 300 $\mu g/m^2$. Since all of the samples were below the detection limit and the primary clearance criterion after the first cleaning, no additional samples were collected for analysis of PAH.

Unit 5D – This unit is on the fifth floor. It is a 1,024 sq. ft. open loft facing the World Trade Center site. This unit had windows that were blown in, which resulted in significant dust accumulation. The dwelling has hardwood floors with no carpet. All personal items were removed prior to cleaning.

Cleaning Method – This unit was cleaned using Test 3B: an industrial HEPA-filtered vacuum and

an AFD. All horizontal surfaces were wet wiped.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned one time.

Asbestos

Before Cleaning Samples – Two micro vacuum and five wipe samples were collected for analysis of asbestos. These samples indicate that asbestos was present in the unit prior to cleaning. The two micro vacuum samples detected chrysotile above the detection limit. Three of the five wipe samples were below the detection limit, although four of the five wipe samples detected either chrysotile or amosite.

Post 1st Cleaning Samples – Three air, two micro vacuum and five wipe samples were collected for asbestos. The samples were analyzed for PCM and PCMe. The PCM results indicate all three air samples were below the secondary numeric criterion of 0.01 f/cc. The PCMe results indicate that all three of the samples were below the primary clearance criterion of 0.0009 S/cc.

The results of the two micro vacuum samples indicate that asbestos was present at levels somewhat similar to those observed before cleaning.

The results of the five wipe samples indicate that asbestos was below the concentrations observed in the pre-cleaning samples and was below the detection limit for all samples.

Dioxin

Before Cleaning Samples – Four wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was not present and that the TEQ concentration for all samples was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four post-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that there was dioxin present; however, the TEQ concentration was below the primary clearance criterion of 4 ng/m^2 and similar to pre-cleanup concentrations.

Gypsum

Before Cleaning Samples - Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples - Two air samples were collected after the first cleaning. Gypsum was not detected above the detection limit of 0.016 mg/m^3 in the air samples.

Lead

Before Cleaning Samples - Two micro vacuum samples and four wipe samples were collected. Lead was detected in both micro vacuum samples and two of the four wipe samples at concentrations above the comparison value or primary clearance criterion of 25 $\mu g/ft^2$. The micro vacuum samples exceeded the comparison value, ranging from 27.1 $\mu g/ft^2$ to 49.1 $\mu g/ft^2$, and the two wipe samples exceeded the primary clearance criterion, ranging from 25.3 $\mu g/ft^2$ and 32.1 $\mu g/ft^2$.

Post 1st Cleaning Samples (*Test 3B)* – Two air samples, two micro vacuum samples, and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion of 1.0 μg/m^3. The results of the micro vacuum and wipe samples show that all samples met the comparison value or primary clearance criterion for lead.

Alpha-Quartz
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

MMVF
Before Cleaning Samples – Four wipe samples were collected. The four wipe samples evidenced MMVF above the detection limit, which indicates that MMVF was present prior to cleaning.

Post 1st Cleaning Samples – Three air samples and five wipe samples were collected after the first cleaning. All of the air sample results indicate that MMVF was present, but at levels below the primary clearance criterion of 10 S/L. All of the wipe sample results were in the range of 114.46 S/cm^2 to 228.93 S/cm^2. This indicates that the cleaning method was able to reduce the pre-cleaning concentration of MMVF.

PAH
Before Cleaning Samples – Four wipe samples were collected. All four samples were below the detection limit, and the TEF of 300 μg/m^2.

Post 1st Cleaning Samples – Four wipe samples were collected. All four samples were below the detection limit; the TEF value was below the primary clearance criterion of

300 µg/m^2.

Fifth Floor Hallway – The fifth floor hallway is an area with plywood floors and walls made of sheet rock covered with wallpaper glue. The ceiling is also made of sheet rock, and is painted.

Cleaning Method – This area was cleaned twice using Test 4A and Test 4B. Test 4A used an industrial HEPA-filtered vacuum and an AFD, while Test 4B consisted of a soap and water wet wipe of only the ceiling.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned twice.

Asbestos
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected. The air samples were analyzed using PCM. The PCM results were below the secondary numeric criterion of 0.01 f/cc. The samples could not be analyzed for PCMe, due to overloading of particulate matter on the filters.

Post 2nd Cleaning Samples – Two air samples were collected. The air samples were analyzed using TEM AHERA, and PCMe. The samples could not be analyzed for PCM, due to overloading of particulate matter on the filters. The TEM AHERA results were below the secondary numeric criterion of 0.022 S/cc, with the samples being below the detection limit. Similarly, the PCMe results were below the primary clearance criterion of 0.0009 S/cc with the samples likewise below the detection limit.

Dioxin
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – There were no post-first cleaning samples collected.

Post 2nd Cleaning Samples – There were no post-second cleaning samples collected.

Gypsum
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. Gypsum was not detected. Since gypsum was below the detection for the sample collected, no additional gypsum samples were collected.

Lead
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. The air sample was below the primary clearance criterion of 1.0 µg/m^3. Since the primary

clearance criterion was met for lead after the first cleaning, no additional lead samples were collected.

Alpha-Quartz
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. The sample was below the detection limit. Because the sample was below the detection limit after the first cleaning, no additional samples were collected for analysis of alpha-quartz.

Calcite
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. The sample was below the detection limit. Because the sample was below the detection limit after the first cleaning, no additional samples were collected for analysis of calcite.

Cristobalite
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning; the sample was below the detection limit. Because the sample was below the detection limit after the first cleaning, no additional samples were collected for analysis of cristobalite.

Tridymite
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – One air sample was collected after the first cleaning. The sample was below the detection limit. Since the sample was below the detection limit after the first cleaning, no additional samples were collected for tridymite.

MMVF
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. The results indicate that MMVF was present in both samples; however, the concentrations were below the primary clearance criterion of 10 S/L. Because the air samples were below the primary clearance criterion, no additional samples were collected for MMVF.

PAH
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – There were no post-first cleaning samples collected.

Post 2nd Cleaning Samples – There were no post-second cleaning samples collected.

Barber Shop – The Barber Shop is located below grade to Liberty Street. This 1,268 sq. ft. open space faces the WTC site. The front door of the business was blown inward. Significant amounts of dust and debris were deposited down into the staircase into the rental space. Floor areas are covered with ceramic tiles. The ceiling is a suspended system composed of fibrous tiles. A void space is above the suspended ceiling, The void space accommodates flexible A/C ducts, electrical conduit and lights. All structural support members above the ceiling are encapsulated with a non-asbestos insulating material. Equipment including chairs, wash sinks, counters and hair care displays were located in the shop. The head space above the entrance door houses a condenser/compressor unit that was heavily impacted with WTC-related dust and debris. Ceiling tiles, flexible duct, chairs, display shelving, and hair care merchandise were disposed of prior to cleaning. Ancillary rooms that extend under Liberty Street are adjacent to the shop space. These rooms have earthen floors and are believed to be associated with utility companies. They were not cleaned.

Cleaning Method – This unit was cleaned using Test 4A and Test 4E. Test 4A consisted of use of an industrial HEPA vacuum to vacuum floors and other surfaces. An AFD was used during the cleaning process. Test 4E consisted of use of water to wet wipe all horizontal and vertical surfaces.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned once.

Supplemental Sampling Activities – One bulk sample of insulation material was collected to determine its asbestos content, in order to address applicable health and safety concerns. Asbestos was not detected in the sample.

Asbestos

Before Cleaning Samples – Other than the bulk sample mentioned in the previous section, no other pre-cleanup samples were collected.

Post 1st Cleaning Samples – Three air samples were collected for asbestos. The samples were analyzed using PCM, TEM AHERA, and PCMe. The PCM results indicate that all three samples were below the detection limit and below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that all three samples were below the detection limit and below the secondary numeric criterion of 0.022 S/cc. The PCMe results also indicate that all three samples were below the detection limit and were below the primary clearance criterion of 0.0009 S/cc.

Dioxin

Before Cleaning Samples – Four pre-cleaning wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples – Four wipe samples were collected and analyzed for dioxin. The results indicate that the concentrations of dioxin detected were slightly lower than the pre-cleaning samples. The TEQ concentration for each sample was below the criterion of 4 ng/m^2.

Lead
Before Cleaning Samples – Four pre-cleaning wipe samples were collected. Three of the four samples were above the detection limit. The fourth sample was below the detection limit. Two were above the primary clearance criterion of 25 μg/ft^2. Two of the samples were qualified as rejected due to field blank contamination.

Post 1st Cleaning Samples – Two air samples and four wipe samples were collected after the first cleaning. All of the air and wipe samples were below the detection limit and met the primary air and wipe clearance criteria for lead after the first cleaning.

MMVF
Before Cleaning Samples – No pre-cleaning samples were collected for MMVF.

Post 1st Cleaning Samples – Three air samples were collected after the first cleaning. MMVF was detected in two of three samples, but at levels below the primary clearance criterion of 10 S/L.

PAH
Before Cleaning Samples – Four wipe samples were collected. All of the samples were below the detection limit. The TEF for each sample was below the primary clearance criterion. One PAH compound was detected in the fourth sample; however, the TEF was below the primary clearance criterion of 300 μg/m^2.

Post 1st Cleaning Samples – Four wipe samples were collected. All four samples were below the detection limit. The TEF for each sample was below the primary clearance criterion of 300 μg/m^2.

Cedar Street Staircase – This area consisted of wood steps/landings, sheet rock walls and ceiling. Flooring was covered with vinyl tiles; walls and ceilings were covered with gloss paint.

Cleaning Method – This area was cleaned using Test 4A and Test 4B. Test 4A utilized a commercial HEPA-filtered vacuum and an AFD. Test 4B consisted of soap and water wet wipe of all horizontal and vertical surfaces.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned once.

Asbestos
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected. The air samples were analyzed using PCM, TEM AHERA, and PCMe. The PCM results were below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that chrysotile was present, but both samples were below the secondary numeric criterion of 0.022 S/cc. The PCMe results indicate that one sample was below the detection limit and the other had chrysotile present, but at a concentration below the primary clearance

criterion of 0.0009 S/cc.

Gypsum
Before Cleaning Samples – There were no samples collected.

Post 1st Cleaning Samples – Two air samples were collected. Gypsum was not detected in either sample.

Lead
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Lead was not detected in either sample. The results were below the primary clearance criterion of 1.0 $\mu g/m^3$. Because the primary clearance criterion was met for lead after the first cleaning, no additional lead samples were collected.

Alpha-Quartz
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both samples were below the detection limit.

Calcite
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

Cristobalite
Before Cleaning Samples – There were no air samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

Tridymite
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both were below the detection limit.

MMVF
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. The results indicate that MMVF was only present in one sample. Both samples were below the primary clearance criterion of 10 S/L.

Chiropractor's Office – This is a 716 sq. ft. office space with four examination rooms facing the World Trade Center site. All front windows were blown in. Significant amounts of dust were present on all horizontal and vertical surfaces. Floor areas were covered with wall-to-wall carpeting. The suspended ceiling was covered with fibrous tiles. There was a two-foot high void space above the ceiling. The space above the suspended ceiling contained the HVAC system and wood floor joist system for the third floor apartments. This area contained WTC-related and non-WTC- related dust. The space was extremely difficult to clean due to the presence of electrical wires, recessed lighting fixtures, sprinkler systems, and the dry, friable nature of the wood support system. Ceiling tiles, flexible ventilation ducts and office equipment were disposed of prior to cleaning.

Cleaning Method – This unit was the subject of separate tests to evaluate five different cleaning techniques as described below:

Test 4A:	Industrial HEPA-filtered vacuums and AFD.
Test 4B:	Wet wipe all walls.
Test 4C:	Hot water wet vacuum
Test 4D:	A/C Duct Cleaning
Test 4E:	Water only wet-wipe of the bathroom floor and desktop.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after the Test 4E cleaning event except for the lead wipe collected from the bathroom floor.

Supplemental Sampling Activities – Prior to initiating pre-cleaning sampling activities as described below, EPA collected a bulk composite sample from the Chiropractor's Office. The analytical data obtained from the bulk composite was utilized in identifying COPC concentrations present in settled dust, determining the applicability of regulatory standards, and identifying potential health and safety concerns. The Chiropractor's Office was selected, based upon visual observation, as being representative of a "worst case scenario" in the study building.

Asbestos

Before Cleaning Samples – Two air samples, four micro vacuum samples, and five wipe samples were collected for asbestos. The air samples were analyzed for PCM and PCMe. The PCM results indicate that one sample was above the secondary numeric criterion of 0.01 f/cc and one was below this value. The PCMe results were both below the detection limit and below the primary clearance criterion of 0.0009 S/cc. All four of the micro vacuum samples contained chrysotile above the detection limit. All five wipe samples were also above the detection limit, with chrysotile being detected in all five samples and amosite in two of the five samples.

Post 1st Cleaning Samples (*Test 4A)* – Three air, four micro vacuum, and five wipe samples were collected for asbestos. The air samples were analyzed for PCM and PCMe; however, none of the analyses could be completed due to overloading of particulate material.

The results of the four micro vacuum samples indicate that asbestos was present at levels lower than those observed before cleaning.

Asbestos was present in all five wipe samples at lower concentrations than those observed before cleaning. One of the five samples was identified as being below the detection limit.

Post 1st Cleaning Samples (Test 4B) – Three air samples and five wipe samples were collected for asbestos. The air samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results indicate that one sample could not be analyzed due to particulate overloading; two were above the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that two samples could not be analyzed due to particulate overloading; one sample was above the secondary numeric criterion of 0.022 S/cc. The PCMe results indicate that two of the samples could not be analyzed due to particulate overloading; one was above the primary clearance criterion of 0.0009 S/cc.

The results of the five wipe samples indicate that asbestos was present in all five samples at lower concentrations than those observed before cleaning.

Post 1st Cleaning Samples (Test 4C) – Five air samples and four micro vacuum samples were collected for asbestos. The air samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM analysis could not be conducted due to overloading of the filter with particulate matter. The TEM AHERA results indicate that three of the five samples could not be analyzed due to overloading of the filters with particulate material. The remaining two samples were below the secondary numeric criterion of 0.022 S/cc. The PCMe results indicate that three of the five air samples analyzed could not be analyzed due to overloading of particulate matter. The remaining two PCMe results indicate that one sample was below the primary clearance criterion and one sample exceeded the primary clearance criterion of 0.0009 S/cc at 0.0033 S/cc.

The results of the four micro vacuum samples indicate that asbestos was present in all five samples at lower concentrations than those observed before cleaning, but at similar concentrations to those after Test 4A cleaning.

Post 1st Cleaning Samples (Test 4D) – Three air samples were collected for asbestos. The samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results indicate that all three samples were below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that all three samples were below the detection limit and below the secondary numeric criterion of 0.022 S/cc. The PCMe results were all below the detection limit and were below the primary clearance criterion of 0.0009 S/cc.

Dioxin

Before Cleaning Samples – One air sample and four wipe samples were collected and analyzed for dioxin. The results indicate that there was dioxin present; however, the TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples (*Test 4A)* – Four wipe samples were collected and analyzed for dioxin. The TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples (Test 4B) – Four wipe samples were collected and analyzed for

dioxin. The concentrations of dioxin were similar to the pre-cleaning samples. The TEQ concentration for each sample was below the criterion of 4 ng/m^2.

Post 1st Cleaning Samples (*Test 4E*) – Three wipe samples were collected and analyzed for dioxin. The concentrations of dioxin were slightly lower than the pre-cleaning samples. The TEQ concentration for each sample was below the criterion of 4 ng/m^2.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples (Test 4A) – Two air samples were collected. Gypsum was not detected in the air samples above the detection limit range of 0.008 mg/m^3 to 0.017 mg/m^3.

Post 1st Cleaning Samples (Test 4B) – Two air samples were collected. Gypsum was detected in air at concentrations of 0.011 mg/m^3 and 0.014 mg/m^3.

Post 1st Cleaning Samples (Test 4C) – Two air samples were collected. Gypsum was detected in air above the detection limit with the results of 0.009 mg/m^3 to 0.012 mg/m^3.

Lead

Before Cleaning Samples – Four micro vacuum samples and four wipe samples were collected. Lead was detected in all of the micro vacuum samples and wipe samples. Three of the four micro vacuum results exceeded the comparison value of 25 µg/ft^2, ranging from 28.2 µg/ft^2 to181 µg/ft^2. Wipe sample concentrations exceeded the primary clearance criterion of 25 µg/ft^2 in all of the samples, ranging in concentrations from 74.7 µg/ft^2 to 433 µg/ft^2.

Post 1st Cleaning Samples (*Test 4A)* – Two air samples, four micro vacuum samples, and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion of 1.0 µg/m^3. The results of the micro vacuum and wipe samples show that, while all of the micro vacuum and two of the wipes samples were below the comparison value or primary clearance criterion. The remaining two wipe samples exceeded the primary clearance criterion with concentrations of 64.5 µg/ft^2 and 146 µg/ft^2.

Post 1st Cleaning Samples (Test 4B) – Two air samples and four wipe samples were collected. The two air samples were below the primary clearance criterion of 1.0 µg/m^3. Two of the four wipe samples exceeded the primary clearance criterion at concentrations of 147 µg/ft^2 and 556 µg/ft^2.

Post 1st Cleaning Samples (Test 4C) – Two air samples and four micro vacuum samples were collected. The two air samples both exceeded the primary clearance criterion at 1.89 µg/m^3 and 2.56 µg/m^3. All four micro vacuum samples were below the comparison value of 25 µg/ft^2.

Post Cleaning Samples (Test 4D) – Two air samples were collected. Both were below the detection limit of 0.052 μg/m^3 and the primary clearance criterion of 1.0 μg/m^3.

Post 1st Cleaning Samples (Test 4E) – Three wipe samples were collected. Two of the three samples were below their respective primary clearance criterion. The third sample exceeded the primary clearance criterion of 25 μg/ft^2 at a concentration of 954 μg/ft^2.

Alpha-Quartz
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples (Test 4A) – Two air samples were collected after the first cleaning. Samples were below the detection limit.

Post 1st Cleaning Samples (Test 4B) – Two air samples were collected. Samples were below the detection limit.

Post 1st Cleaning Samples (Test 4C) – Two air samples were collected. Both were below the detection limit.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples (Test 4A) – Two air samples were collected after the first cleaning. Samples were below the detection limit.

Post 1st Cleaning Samples (Test 4B) – Two air samples were collected. Samples were below the detection limit.

Post 1st Cleaning Samples (Test 4C) – Two air samples were collected. Both were below the detection limit.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples (Test 4A) – Two air samples were collected after the first cleaning. Both samples were below the detection limit.

Post 1st Cleaning Samples (Test 4B) – Two air samples were collected. Both samples were below the detection limit.

Post 1st Cleaning Samples (Test 4C) – Two air samples were collected. Both were below the detection limit.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples (Test 4A) – Two air samples were collected after the first

cleaning. Both samples were below the detection limit.

Post 1st Cleaning Samples (Test 4B) – Two air samples were collected. Both samples were below the detection limit.

Post 1st Cleaning Samples (Test 4C) – Two air samples were collected. Both were below the detection limit.

MMVF

Before Cleaning Samples – Two air samples and four wipe samples were collected. MMVF was present in both air samples, but below the primary clearance criterion of 10 S/L. The four wipe samples had detectable concentrations of MMVF.

Post 1st Cleaning Samples (Test 4A) – Three air samples and five wipe samples were collected after the first cleaning. All of the air sample results indicate that MMVF was present at levels below the primary clearance criterion of 10 S/L. All of the wipe sample results indicate that MMVF was present at concentrations below pre-cleaning samples.

Post 1st Cleaning Samples (Test 4B) – Three air samples and five wipe samples were collected after the first cleaning. Two of the three air samples exceeded the primary clearance criterion of 10 S/L at 17.579 S/L and 60.606 S/L. All of the wipe samples were below the concentrations detected during pre-cleaning sampling and were similar to the concentrations after Test 4A.

Post 1st Cleaning Samples (Test 4C) – Five air samples were collected after the first cleaning. All of the air samples indicate that MMVF was present at levels below the primary clearance criterion of 10 S/L.

Post 1st Cleaning Samples (Test 4D) – Three air samples were collected after cleaning. All of the air samples indicate that MMVF was present at levels below the primary clearance criterion of 10 S/L.

PAH

Before Cleaning Samples – Two air samples and four wipe samples were collected. The two air samples both detected six PAH compounds; however, the calculated TEFs were below the primary clearance criterion of 0.2 $\mu g/m^3$. Two of the four wipe samples also detected three PAH compounds; however, the calculated TEFs were below the primary clearance criterion of 300 $\mu g/m^2$. The remaining two samples were below the detection limit. The TEF for each sample was below the primary clearance criterion.

Post 1st Cleaning Samples (Test 4A) – Four wipe samples were collected. All four samples were below the detection limit. The TEF for each sample was below the primary clearance criterion of 300 $\mu g/m^2$.

Post 1st Cleaning Samples (Test 4B) – Four wipe samples were collected. All four samples were below the detection limit. The TEF for each sample was below the primary clearance criterion of 300 $\mu g/m^2$.

Post 1st Cleaning Samples (Test 4E) – Three post-cleaning wipe samples were collected. All three samples were below the detection limit. The TEF for each sample was below the primary clearance criterion of 300 μg/m^2.

Elevator Shaft/Compactor Room – This area consisted of an elevator shaft with a soil floor and an adjacent compactor room with a concrete floor. Construction was of cinder block walls and exposed floor joists.

Cleaning Method – This area was cleaned using Test 4A. Test 4A consisted of use of an industrial HEPA-filtered vacuum and an AFD. No wet wiping was performed.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned once.

Asbestos
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Three air samples were collected. The three air samples were analyzed using PCM, TEM AHERA, and PCMe. The three PCM results were all below the secondary numeric criterion of 0.01 f/cc. Two of the three results were below the detection limit. Similarly, the TEM AHERA results were all below the secondary numeric criterion of 0.022 S/cc. All three of the samples were also below the detection limit. The PCMe results were all below the primary clearance criterion of 0.0009 S/cc, with all three of the samples below the detection limit.

Lead
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. The two air samples were below the detection limit.

MMVF
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – Three air samples were collected after the first cleaning. MMVF was present in each of the three samples; however, the concentrations were below the primary clearance criterion of 10 S/L.

The Food Exchange – This unit is a 5,000 sq. ft. restaurant occupying three floors. The first floor is at street level with entrances from both Liberty and Cedar Streets. This floor was used for food service and customer dining. The lower level (basement) was used for food preparation and storage. The third level (sub-basement) was used for storage of restaurant equipment. Ceramic tile covers the floor area in both the dining room and the basement. The floor of the sub-basement is packed soil. All exterior windows had been blown inward depositing significant amounts of dust on all surface areas of the first floor. Minimal dust was present in the basement. The first

floor ceiling by the Liberty Street entrance is made of gypsum board. The ceiling on the Cedar Street entrance consists of suspended acoustical tile covered with decorative tin facing. Above the suspended ceiling is a two-foot void space that houses the HVAC system for the establishment. The basement ceiling is a suspended fibrous tile ceiling. The void space above both suspended ceilings and the gypsum ceiling contained both WTC-related and non-WTC- related dust. Asbestos pipe insulation was present in the void space of the basement. Grills, refrigerators, tables and chairs were present on the first floor. The basement contains walk-in refrigerators, preparation tables, stoves, dishwashing areas and dry goods storage. Prior to cleaning, all open and bulk stored food, fibrous ceiling tiles in the basement, and wrap insulation that had surrounded the HVAC systems were disposed.

Cleaning Method – This unit was cleaned using Test 4A and Test 4D. Test 4A consisted of use of an industrial HEPA-filtered vacuum and an AFD. All horizontal surfaces were wet wiped. Test 4D consisted of cleaning of the HVAC system by a subcontractor utilizing standard industry cleaning techniques.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned once.

Asbestos

Before Cleaning Samples – One wipe sample and one bulk sample were collected from the HVAC system. The wipe sample concentration was below the detection limit, however the detection limit was much higher than the other wipe sample detection limit (approximately 300,000 vs. 3,000). The bulk sample was analyzed by PLM and asbestos was not detected.

Post 1st Cleaning Samples (Test 4A) – Eight air samples were collected for asbestos. The air samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results indicate that six of the samples were below the detection limit and all eight samples were below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that seven of the samples were below the detection limit and all eight samples were below the numeric criterion of 0.022 S/cc. The PCMe results indicate that all eight of the air samples were below the detection limit and below the primary clearance criterion of 0.0009 S/cc.

Post 1st Cleaning, HVAC System – Three air and two wipe samples were collected. The air samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results indicate that all of the samples were below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that two of the samples were below the detection limit and the third was at the detection limit with all three being below the secondary numeric criterion of 0.022 S/cc. The PCMe results indicate that two of the samples were below the detection limit and the third was at the detection limit with all three being below the primary clearance criterion of 0.0009 S/cc.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples, HVAC System – One air sample was collected after the first

cleaning. Gypsum was not detected above the detection limit of 0.008 mg/m^3 in the air sample.

Lead (HVAC)
Before Cleaning Samples – One wipe sample was collected from the HVAC system. Lead was detected above the primary clearance criterion of 25 $\mu g/ft^2$ at 1310 $\mu g/ft^2$.

Post 1st Cleaning Samples, *HVAC System* – Two air samples and two wipe samples were collected after the first cleaning. The two air samples were below the detection level and primary clearance criterion of 1.0 $\mu g/m^3$. Lead concentrations exceeded the primary clearance criterion at 136 $\mu g/ft^2$ and 183 $\mu g/ft^2$. The post-cleaning lead exceedances were attributed to the composition of the HVAC construction material.

Post 1st Cleaning Samples (Test 4A) – Five air samples were collected. All were below the detection level.

Alpha-Quartz (HVAC)
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples, HVAC System – One air sample was collected after the first cleaning. The air sample was below the detection limit.

Calcite (HVAC)
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples, HVAC System – One air sample was collected. The air sample was below the detection limit.

Cristobalite (HVAC)
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples, HVAC System – One air sample was collected after the first cleaning. The air sample was below the detection limit.

Tridymite (HVAC)
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples, HVAC System – One air sample was collected. The air sample was below the detection limit.

MMVF (HVAC)
Before Cleaning Samples – One sample was collected. The wipe sample had an MMVF concentration of 11732.44 S/cm^2.

Post 1st Cleaning Samples, *HVAC System* – Three air samples and two wipe samples were collected. All of the air and wipe sample results indicate that MMVF concentrations were below the detection limit and that the air samples were below the primary clearance

criterion of 10 S/L. This indicates that the cleaning method was able to reduce the pre-cleaning concentration of MMVF in the HVAC system.

Post 1st Cleaning Samples (Test 4A) – Eight air samples were collected. All sample concentrations were below the primary clearance criterion of 10 S/L. Six of the eight samples were below the detection limit.

Total Dust
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples, HVAC System – The results for the micro vacuum sample indicated that dust was present below the clearance criteria of 0.5 mg/cm^2. This value is lower than the clearance criteria set by NADCA.

Lemongrass Grill – This unit is 3,500 square feet in area with two floors. All exterior windows facing the WTC were blown inward depositing significant amounts of dust on all surfaces of the first floor. Minimal dust was present in the basement. The first floor is at street level with entrances from both Liberty and Cedar Streets. The lower level (basement) was used for food preparation and storage. Gypsum ceilings and hardwood floors are present throughout the dining area. Wood floor joists and sub-floor from the first floor constitute the basement ceiling. The dining area is decorated with Thai accents consisting of bamboo and thatch.

Grills, ovens, refrigerators, tables, chairs and a bar are on the first floor. The basement contains a walk-in refrigerator, freezers, preparation table, dishwasher, and dry goods storage. The floor of the basement is concrete. The establishment's HVAC system is suspended from the ceiling of the first floor.

Prior to cleaning, all tables, chairs, containerized food and accent decorations were disposed. Restaurant equipment including woks, utensils, pots, pans, and flatware were vacuumed and washed.

Cleaning Method – This unit was cleaned using Test 4A and Test 4D. Test 4A consisted of use of an industrial HEPA-filtered vacuum and an AFD. Test 4D consisted of professional cleaning of the HVAC system using standard industry techniques. All horizontal surfaces were wet wiped. This cleaning method was used for each cleaning event. The HVAC system was also cleaned and tested.

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after being cleaned twice. The HVAC met the clearance criteria after being cleaned once.

Asbestos
HVAC Cleaning Results – One wipe sample and one bulk sample were collected from the HVAC system. The wipe sample concentration was below the detection limit, however the detection limit was much higher than the other wipe sample detection limit (approximately 12,000 vs. 3,000). The bulk sample was analyzed by PLM and found to be less than one percent asbestos.

Post 1st Cleaning – Five air samples were collected from the first floor and one air sample was collected from the basement. The samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM, TEM AHERA and PCMe analyses of the five samples collected from the first floor could not be conducted due to overloading of particulate material. The sample collected from the basement met the primary clearance criterion and secondary numeric criterion.

Post 2nd Cleaning – Seven air samples were collected after the second cleaning. The samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results were all below the secondary numeric criterion of 0.01 f/cc. Five of the samples were below the detection limit. The TEM AHERA results were all below the secondary numeric criterion of 0.022 S/cc, with six of the seven samples below the detection limit. The PCMe results were all below the primary clearance criterion of 0.0009 S/cc, with six of the seven samples below the detection limit. The seventh sample was at the detection limit of 0.0005 S/cc. This indicates that the cleaning techniques were effective at removing particulate matter after the first cleaning, which allowed valid asbestos air samples to be collected. The results indicate that the unit met the primary clearance and secondary numeric criteria.

HVAC System – Four air samples and two wipe samples were collected after the HVAC system was cleaned. The air samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results were all below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that two samples were below the detection limit and that two samples were equal to the detection limit of 0.0005 S/cc. The PCMe results indicate that all four samples were below the detection limit of 0.0005 S/cc.

The results for the two asbestos wipe samples indicate that both samples were below the detection limit. The detection limit (12,100 S/cm^2) was higher than the detection limit (approximately 3,000 S/cm^2) for most other wipe samples on this project.

Dioxin

Before Cleaning Samples – There were no samples collected and analyzed for dioxin.

Post 1st Cleaning Samples – There were no samples collected and analyzed for dioxin.

HVAC System – There were no samples collected and analyzed for dioxin.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected. .

Post 1st Cleaning Samples – There were no samples collected after the first cleaning for gypsum.

HVAC System – One air sample was collected for gypsum. This sample was below the detection limit.

Lead (HVAC)
Before Cleaning Samples – One wipe sample was collected. Lead was detected at a concentration above the primary clearance criterion of 25 μg/ft^2 with a value of 10700 μg/ft^2.

Post 1st Cleaning Samples – Four air samples were collected. All four samples were below the primary clearance criterion of 1.0 μg/m^3. One of these samples was collected from the basement.

HVAC System – Three air samples and two wipe samples were collected after the HVAC system was cleaned. The air sample results indicate that all three air samples were below the detection limit. The two wipe sample results indicated that lead was still present at 25.9 μg/ft^2 and 166 μg/ft^2. Both of these results were above the primary clearance criterion. Post cleaning lead exceedances were attributed to the composition of the HVAC construction material.

Alpha-Quartz (HVAC)
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – There were no samples collected after the first cleaning.

HVAC System – One air sample was collected. The air sample was below the detection limit.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – There were no samples collected after the first cleaning.

HVAC System – One air sample was collected after the HVAC system was cleaned. This sample was below the detection limit.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – There were no samples collected after the first cleaning.

HVAC System – One air sample was collected after the HVAC system was cleaned. This sample was below the detection limit.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples – There were no samples collected after the first cleaning.

HVAC System – One air sample was collected after the HVAC system was cleaned. This sample was below the detection limit.

MMVF
Before Cleaning Samples – One wipe sample was collected. The sample was below the detection limit.

Post 1st Cleaning Samples – Five air samples were collected after the first cleaning. MMVF was below the detection limit.

HVAC System – Four air and two wipe samples were collected after the HVAC system was cleaned. The results for all air and wipe samples indicate that MMVF was below the detection limit and that the air samples were below the primary clearance criteria of 10 S/L.

Post 2nd Cleaning Samples – One air sample was collected after the second cleaning. The result was below the detection limit.

PAH
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – There were no samples collected after the first cleaning.

Total Dust
Before Cleaning Samples – There were no samples collected before cleaning.

Post 1st Cleaning Samples – There were no samples collected after the first cleaning.

HVAC System – One micro vacuum sample was collected. The results for the micro vacuum sample indicate that dust was present below the clearance criterion of 0.50 mg/cm^2. This value is lower than the clearance criterion set by NADCA.

Liberty Street Staircase – The stairwell consisted of cast concrete steps/landings, sheet rock walls and ceiling. All surfaces were covered with gloss paint.

Cleaning Method – This area was cleaned using Test 4A and Test 4B. Test 4A consisted of use of an industrial HEPA-filtered vacuum and an AFD. Test 4B consisted of soap and water wet wipe of all horizontal and vertical surfaces.

Cleaning Results – This area did not meet the primary clearance criterion for alpha-quartz listed in Table 1.0. Due to a delay in receiving analytical results, this exceedance was not identified until after the close of the study. However, the only elevated sampling result for airborne alpha-quartz was obtained from the Liberty Street staircase. This result is inconsistent with the other 53 samples taken throughout apartments and common spaces in the building. Those results were all reported to be below the detection limit. Consequently, the presence of a single elevated sample result in a low occupancy area of the building is not indicative of a health hazard.

Asbestos
Before Cleaning Samples – There were no samples collected.

Post 1st Cleaning Samples – Two air samples were collected for asbestos. These samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results were all below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that one was below the detection limit and one was at the detection limit. Both samples were below the secondary numeric criterion of 0.022 S/cc. The PCMe results indicate that one was below the detection limit and one was at the detection limit. Both samples were below the primary clearance criterion of 0.0009 S/cc.

Gypsum
Before Cleaning Samples – There were no samples collected.

Post 1st Cleaning Samples – Two air samples were collected. Gypsum was not detected.

Lead
Before Cleaning Samples – There were no samples collected.

Post 1st Cleaning Samples – Two air samples were collected for lead. Lead was not detected in either sample.

Alpha-Quartz
Before Cleaning Samples – There were no samples collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. One sample exceeded the primary clearance criterion of .004 mg/m^3. Alpha-quartz was not detected in the remaining sample.

Calcite
Before Cleaning Samples – There were no samples collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both samples were below the detection limit.

Cristobalite
Before Cleaning Samples – There were no samples collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both samples were below the detection limit.

Tridymite
Before Cleaning Samples – There were no samples collected.

Post 1st Cleaning Samples – Two air samples were collected after the first cleaning. Both samples were below the detection limit.

MMVF
Before Cleaning Samples – There were no samples collected.

Post 1st Cleaning Samples – Two air samples were collected. The results for both samples were below the primary clearance criterion of 10 S/L.

Mattress Store – This is a 968 sq. ft. open space facing the World Trade Center site. All front windows were blown in. Significant amounts of dust were present on all horizontal surfaces. Floor areas were covered with wall-to-wall carpeting. Approximately 25 display mattresses and box springs were present. Ceiling tiles, mattresses, office equipment and flexible ventilation ducts were removed and disposed of prior to cleaning. The space above the suspended ceiling exhibited the same characteristics as in the Chiropractor's Office.

Cleaning Method – This unit was the subject of separate tests to evaluate five different cleaning techniques as described below:

Test 4A:	Industrial HEPA-filtered vacuums and AFD
Test 4B:	Wet wipe all walls
Test 4C:	Hot water carpet shampoo
Test 4D:	A/C duct cleaning
Test 4E:	Cleaning of vinyl floor tile and wet wipe of window ledge using water only

Cleaning Results – This unit met the clearance criteria listed in Table 1.0 for each compound after the Test 4E cleaning event except for one lead wipe which was collected from a window ledge.

Supplemental Sampling Activities – Prior to initiating pre-cleaning sampling activities as described below, EPA collected a bulk composite sample from the Mattress Store. The analytical data obtained from the bulk composite was utilized in identifying COPC concentrations present in settled dust, determining the applicability of regulatory standards, and identifying potential health and safety concerns. The Mattress Store was selected, based upon visual observation, as being representative of a "worst case scenario" in the study building.

Asbestos

Before Cleaning Samples – Four air, seven micro vacuum, and three wipe samples were collected for asbestos. The air samples were analyzed for PCM and PCMe. The PCM results indicate that two of the samples were above and two of the samples were below the secondary numeric criterion of 0.01 f/cc. The PCMe results indicate that two of the samples could not be analyzed due to overloading of particulate material. The remaining two samples were below the detection limit and below the primary clearance criterion of 0.0009 S/cc. All seven of the micro vacuum samples and all three of the wipe samples detected chrysotile.

Post 1st Cleaning Samples (Test 4A) – Three air samples, seven micro vacuum samples and four wipe samples were collected for asbestos. The air samples were analyzed for PCM, TEM AHERA, and PCMe. The PCM results indicate that all three samples were below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that two of the samples could not be analyzed due to overloading of particulate material. The remaining sample was below the secondary numeric criterion of 0.0022 S/cc. The PCMe results indicate that two of the samples could not be analyzed due to overloading of

particulate material. The remaining sample was below the primary clearance criterion of 0.0009 S/cc. The results of the seven micro vacuum samples indicate that asbestos was present at concentrations lower than those observed before cleaning. The results of the wipe samples indicate that asbestos was present in all four samples at higher concentrations than those observed before cleaning.

Post 1st Cleaning Samples (Test 4B) – Three air samples and four wipe samples were collected for asbestos. The three air samples were analyzed using PCM, TEM AHERA, and PCMe. The PCM results indicate that two samples could not be analyzed due to overloading of particulate material and one sample was above the secondary numeric criterion of 0.01 f/cc. The TEM AHERA and PCMe analyses could not be analyzed due to overloading of particulate matter.

Asbestos was present in three of the four wipe samples at higher concentrations than those observed before cleaning, but similar to the Test 4A samples. One sample was recorded as below the detection limit; however, the detection limit was greater than normal due to the presence of particulate material.

Post 1st Cleaning Samples (Test 4C) – Five air and seven micro vacuum samples were collected. Five air samples were analyzed using PCM, TEM AHERA, and PCMe. The PCM results indicate that all five samples were below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that all five samples were below the secondary numeric criterion of 0.022 S/cc. The PCMe results indicate that all five samples were above the primary clearance criterion of 0.0009 S/cc. The results of the seven micro vacuum samples indicate that asbestos was present in concentrations above the detection level in four of the seven samples. However, post-cleanup sample concentrations were lower than those observed before cleaning and after Test 4A cleaning.

Post 1st Cleaning Samples (Test 4D) – Three air samples were collected and analyzed using PCM, TEM AHERA, and PCMe. The PCM results indicate that all three samples were below the detection limit and below the secondary numeric criterion of 0.01 f/cc. The TEM AHERA results indicate that all three samples were below the detection limit and below the secondary numeric criterion of 0.022 S/cc. The PCMe results indicate that all three samples were below the detection limit and below the primary clearance criterion of 0.0009 S/cc.

<u>Dioxin</u>

Before Cleaning Samples – Two air samples and three wipe samples were collected and analyzed for dioxin. The results indicate that dioxin was present; however, the TEQ concentration for each sample was below the primary clearance criterion of 0.001 ng/m^3 for air and 4 ng/m^2 for settled dust.

Post 1st Cleaning Samples (Test 4A) – Four wipe samples were collected and analyzed for dioxin. The concentrations of dioxin were similar to the pre-cleaning samples. The TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples (Test 4B) – Four post-cleaning wipe samples were collected

and analyzed for dioxin. The concentrations of dioxin were slightly higher than the pre-cleaning samples. The TEQ concentration for each sample was below the primary clearance criterion of 4 ng/m^2.

Post 1st Cleaning Samples (Test 4E) – Two post-cleaning wipe samples and two pre-water wipe samples were collected and analyzed for dioxin. The results indicate that the concentrations of dioxin were similar to the pre-cleaning samples. TEQ concentrations were below the primary clearance criterion of 4 ng/m^2.

Gypsum

Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples (Test 4A) – Two air samples were collected. Gypsum was not detected in the air samples above the detection limit.

Post 1st Cleaning Samples, (Test 4B) – Two air samples were collected. Gypsum was not detected in the air samples above the detection limit.

Post 1st Cleaning Samples, (Test 4C) – Two air samples were collected. Gypsum was not detected in the air samples above the detection limit.

Lead

Before Cleaning Samples – Seven micro vacuum samples and three wipe samples were collected. All seven micro vacuum samples were below the comparison value of 25 μg/ft^2. Two of the three wipe samples were above the primary clearance criterion of 25 μg/ft^2. The third was below the detection limit. Concentrations of lead in the two wipe samples, which exceeded the primary clearance criterion of 25 μg/ft^2, were 38.9 μg/ft^2 and 77 μg/ft^2.

Post 1st Cleaning Samples (Test 4A) – Two air samples, seven micro vacuum samples, and four wipe samples were collected after the first cleaning. The two air samples were below the primary clearance criterion of 1.0 μg/m^3. Five of the seven micro vacuum samples were below the detection limit. All seven samples were below the comparison value. Two of the four wipe samples exceeded the primary clearance criterion with concentrations of 42.2 μg/ft^2 and 43.9 μg/ft^2. Of the remaining two samples, one was below the primary clearance criterion and both were below the detection limit and below the primary clearance criterion.

Post 1st Cleaning Samples (Test 4B) – Two air samples and four wipe samples were collected. The two air samples were below the primary clearance criterion of 1.0 μg/m^3. Two of the four wipe samples exceeded the primary clearance criterion with concentrations of 91.5 μg/ft^2 and 79.3 μg/ft^2. Of the remaining two, one was below the primary clearance criterion and the other was below the detection limit.

Post 1st Cleaning Samples (Test 4C) – Two air samples and seven micro vacuum samples were collected. The two air samples were below the primary clearance criterion of 1.0 μg/m^3. All seven micro vacuum samples were below the comparison value of 25 μg/ft^2.

Six were below the detection limit.

Post 1st Cleaning Samples (Test 4D) – Two air samples were collected, both with results below the 0.051 µg/m^3 detection limit as well as the primary clearance criterion of 1.0 µg/m^3.

Post Cleaning Samples (Test 4E) – Three wipe samples were collected. The glass jars containing two of the samples were broken at the laboratory; however, the laboratory was able to analyze these samples. The samples were below the primary clearance criterion of 25 µg/ft^2. The third sample exceeded the primary clearance criterion at a concentration of 38.2 µg/ft^2. Re-cleaning and testing at this location was not performed since this sample was collected on a window sill which was later painted by the property owner.

Alpha-Quartz
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples (Test 4A) – There were two air samples collected after the first cleaning. Both air samples were below the detection limit.

Post 1st Cleaning Samples (Test 4B) – Two air samples were collected. Both samples were below the detection limit.

Post 1st Cleaning Samples (Test 4C) – Two air samples were collected. Both were below the detection limit.

Calcite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples (Test 4A) – Two air samples were collected. Both air samples were below the detection limit.

Post 1st Cleaning Samples (Test 4B) – Two air samples were collected. Both samples were below the detection limit.

Post 1st Cleaning Samples (Test 4C) – Two air samples were collected. Both were below the detection limit.

Cristobalite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples (Test 4A) – Two air samples were collected after the first cleaning. Both air samples were below the detection limit.

Post 1st Cleaning Samples (Test 4B) – Two air samples were collected. Both samples were below the detection limit.

Post 1st Cleaning Samples (Test 4C) – Two air samples were collected. Both were below

the detection limit.

Tridymite
Before Cleaning Samples – Pre-cleaning air samples were not collected.

Post 1st Cleaning Samples (Test 4A) – Two air samples were collected. Both air samples were below the detection limit. .

Post 1st Cleaning Samples (Test 4B) – Two air samples were collected. Both samples were below the detection limit.

Post 1st Cleaning Samples (Test 4C) – Two air samples were collected. Both were below the detection limit.

MMVF
Before Cleaning Samples – Four air samples and three wipe samples were collected. All four air samples were above the detection limit. MMVF was detected above the primary clearance criterion of 10 S/L in two of the four air samples. The three wipe samples had detectable concentrations of MMVF.

Post 1st Cleaning Samples (Test 4A) – Three air samples and four wipe samples were collected. MMVF was present in all, but at concentrations below the primary clearance criterion of 10 S/L. All of the wipe sample results were below the concentrations detected during pre-cleaning sampling, with one below the detection limit.

Post 1st Cleaning Samples (Test 4B) – Three air samples and four wipe samples were collected after the first cleaning. All three of the air samples were below the primary clearance criterion of 10 S/L. All of the wipe samples were below the concentrations detected during pre-cleaning sampling, with one below the detection limit.

Post 1st Cleaning Samples (Test 4C) – Five air samples were collected after the first cleaning. MMVF was present in all, but at concentrations below the primary clearance criterion of 10 S/L.

Post 1st Cleaning Samples (Test 4D) – Three air samples were collected after cleaning. All were below the detection limit and below the primary clearance criterion of 10 S/L.

PAH
Before Cleaning Samples – One air sample and three wipe samples were collected. The air sample was below the detection limit. The TEF was below the primary clearance criterion of 0.2 $\mu g/m^3$. Two of the three wipe samples had PAH compounds detected. One sample detected three PAH compounds and the other detected two PAH compounds. The calculated TEFs for these two samples, as well as the third sample, were below the primary clearance criterion of 300 $\mu g/m^2$.

Post 1st Cleaning Samples (Test 4A) – Four post-cleaning wipe samples were collected. All four were below the detection limit; the TEF for each sample was below the primary

clearance criterion of 300 μg/m^2.

Post 1st Cleaning Samples (Test 4B) – Four post-cleaning wipe samples were collected. All four samples were below the detection limit; the TEF for each sample was below the primary clearance criterion of 300 μg/m^2.

Post 1st Cleaning Samples (Test 4E) – Two wipe samples were collected. Both were below the detection limit; the TEF for each was below the primary clearance criterion of 300 μg/m^2.

5. Discussion

This project was an essential element of EPA's efforts in responding to concerns raised by residents of lower Manhattan regarding the presence of WTC dust in their homes. EPA endeavored to confirm that the cleaning methods that individuals were using, and that representatives of health and environmental agencies had recommended, were effective in removing the dust generated by the unprecedented disaster.

Concurrent with this study, EPA conducted the Indoor Air Residential Assistance-WTC Dust Cleanup Program, cleaning residential spaces for residents of lower Manhattan who expressed interest. It was imperative to complete this study as quickly as possible to determine if the routine cleaning procedures being employed in the WTC Dust Cleanup Program required modification.

The study addressed cleaning of a complex mixture of contaminants, including construction debris and fire-related compounds. As noted in the Executive Summary, EPA was unaware of a precedent for an indoor environmental cleanup with such a diverse set of parameters. However, time pressure did not allow for conducting extensive research on potential cleaning techniques in a controlled setting. The urgent and real-time need to determine the effectiveness of the cleaning methods being used by residents and being employed in the WTC Dust Cleanup Program drove the decision to field test the effectiveness of the standard dust removal methods in a heavily-impacted unoccupied building.

Multiple endpoints were used in the study to ensure that the complexity of the dust was comprehensively considered. Sampling for a variety of compounds was conducted before and after cleaning. Clearance was determined by the removal of contaminants to the health-based benchmarks established in the COPC/Benchmark Report.

The study used a combination of data sets to determine the extent of contamination, the effectiveness of the cleaning methods, and the differences across various sampling and analytical methods.

5.1 Data Sets

Many different samples from multiple media for specific compounds were collected over the course of the study which resulted in a variety of data sets being generated. Different data sets were used to evaluate the objectives listed above. Multiple data sets were used for determining the extent of contamination before any cleaning events occurred and for evaluating the effectiveness of various cleaning methods.

The most informative data sets included results from asbestos wipe sampling, lead wipe and micro vacuum sampling and MMVF wipe sampling events conducted before and after first cleaning of the residential units. The majority of results for other compounds for which wipe samples were collected before and after first cleaning (e.g., dioxin, PAH) were below the detection limits for both sampling events. Therefore, these data sets did not provide a useful basis for determining the extent of contamination prior to cleaning or for evaluating the effectiveness of the cleaning methods. Pre-cleaning air sampling was not conducted because of concerns that the presence of significant levels of dust accumulation might make overloading of filters more likely using the

aggressive technique.

The results from the two commercial units included as part of the study could not be used to evaluate existing contamination or overall cleaning efficiency, in as much as the cleaning and sampling process that was used in the commercial units differed from the cleaning and sampling process that was used in the residential units. The non-study commercial units were sampled only for post-cleaning clearance confirmation.

It should be noted that samples were collected for alpha-quartz, calcite, gypsum, tridymite, crystobalite and total dust. However, data for these parameters are not included in this document due to uncertainties in the analytical results. Another data set, asbestos micro vacuum samples, was also not included for evaluating the extent of contamination or cleaning efficiency because the results were extremely variable and did not present consistent trends, as did other data. A work group of the Interagency Indoor Air Task Force debated the inclusion of asbestos micro vacuuming in this study as a result of concerns that the results would not be relevant because, as stated in the ASTM - Standard Test Method for Micro Vacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations: "…the collection efficiency of this technique is unknown and will vary among substrates."[19] This uncertainty, combined with the high degree of uncertainty in predicting airborne asbestos levels based on the amount in settled dust[20] and the variable nature of the asbestos micro vacuum results, limited the use of this data set. Despite these concerns and the quantitative limitations of the method, micro vacuuming was used in an effort to assess the presence of asbestos.

The data sets that did not provide adequate information for determining the extent of existing contamination and the efficiency of cleaning methods, were useful, in combination with the other data sets, to address variances in the use of different sampling and analytical methods, and the use of different equipment.

5.2 Extent of Contamination

This study was designed to establish the effectiveness of a variety of cleaning methods in removing dust and associated materials related to the WTC collapse. In order to evaluate different cleaning methods, the degree of contamination prior to cleaning needed to be assessed. This was accomplished by visually observing the amount of dust in an apartment and by collecting samples prior to cleaning events.

Qualitative visual observations of the quantities of WTC dust that had been deposited into each

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[19]American Society for Testing and Materials. (1995*). Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations*. (ASTM Publication No. D576-95.) West Conshohocken, PA.

[20]The uncertainty of predicting airborne asbestos levels based on settled dust was recently reiterated by a panel of experts that peer reviewed an EPA report that proposed a health-based benchmark for asbestos in settled dust based on utilizing a K factor approach. Specifically, the peer review panel (www.tera.org) stated:

> "The panel did not endorse the asbestos settled dust benchmark because the only relevant exposure pathway for asbestos is inhalation and the K-factor methodology is, at this time, inadequate for predicting inhalation exposure from asbestos surface loading measurements."

apartment were recorded in the initial phase of the study, prior to cleaning. Six apartments were identified as having accumulated a significant amount of dust. The remaining seven apartments were identified as having a minimal amount of dust accumulation. All of the apartments characterized as containing a significant amount of dust presented windows that had been blown in during the collapse of the WTC. The visual observations were used in an attempt to distribute the cleaning methods evenly, based on the amount of dust present.

Once the analytical results were available, it was possible to quantitatively determine differences that existed in the amount of contamination that was present in the apartments prior to cleaning. As indicated above, the pre-cleaning results for asbestos wipe sampling, lead wipe and micro vacuum sampling, and MMVF wipe sampling results from the residential units provided the most complete data set for determining the existing contamination in apartments prior to cleaning. These four data sets were used to establish differences in contamination between apartments prior to cleaning.

The results for each data set identified above were averaged by unit, then ranked from the highest concentration t the lowest concentration, which resulted in each unit having four rankings (one for each data set). These rankings are presented in Table 9.0.

The range of the highest concentration to the lowest concentration for each compound or sample type spanned an order of magnitude. One apartment, 4B, did not contain any porous surfaces that could be sampled, therefore there were no micro vacuum samples collected. This prohibited this unit from being included in the ranking.

Once the units were assigned a ranking for each data set, the rankings for each unit were summed to create a variable called "sum of ranks". This information is presented in Table 10.0. The sum of ranks has a theoretical range of 4-48, while the observed range in this evaluation was 13-45. This indicates that there was generally an even distribution within the theoretical range, with the exception of the lower end of the range, as there were no units which ranked less than 13. Therefore, the visual observations of dust generally corresponded with levels of contamination found in the dust. The results of the ranking evaluation indicates that there was a difference in the degree of an average contamination for these compounds between units prior to the cleaning events.

1.
The study found that there was a pre-cleaning difference in the levels of contamination among the units in the building.

Table 9.0
Ranking of Residential Units for Four Contaminants based on Level of Contamination Before Cleaning [21]

Ranking by Asbestos Wipe Results

Unit	Rank	Asbestos Wipe	Lead Wipe	Lead Microvac	MMVF Wipe
5A	**1**	**65,290**	732	2	799
3D	**2**	**60,623**	81	20	601
5C	**3**	**35,021**	129	177	687
3C	**4**	**34,030**	268	72	477
2B	**5**	**28,092**	40	3	4,731
2A	**6**	**16,607**	34	6	787
4C	**7**	**14,242**	88	75	477
5D	**8**	**9,651**	17	38	441
4D	**9**	**8,861**	52	61	830
3A	**10**	**2,962**	19	5	515
3B	**11**	**2,566**	9	5	1,259
4A	**12**	**2,368**	12	5	401
4B		**7,911**	25	n/a	501

Ranking by MMVF Wipe Results

Unit	Rank	Asbestos Wipe	Lead Wipe	Lead Microvac	MMVF Wipe
2B	**1**	28,092	40	3	**4,731**
3B	**2**	2,566	9	5	**1,259**
4D	**3**	8,861	52	61	**830**
5A	**4**	65,290	732	2	**799**
2A	**5**	16,607	34	6	**787**
5C	**6**	35,021	129	177	**687**
3D	**7**	60,623	81	20	**601**
3A	**8**	2,962	19	5	**515**
3C	**9**	34,030	268	72	**477**
4C	**10**	14,242	88	75	**477**
5D	**11**	9,651	17	38	**441**
4A	**12**	2,368	12	5	**401**
4B		7,911	25	n/a	**501**

Ranking by Lead Wipe Result

Unit	Rank	Asbestos Wipe	Lead Wipe	Lead Microvac	MMVF Wipe
5A	**1**	65,290	**732**	2	799
3C	**2**	34,030	**268**	72	477
5C	**3**	35,021	**129**	177	687
4C	**4**	14,242	**88**	75	477
3D	**5**	60,623	**81**	20	601
4D	**6**	8,861	**52**	61	830
2B	**7**	28,092	**40**	3	4,731
2A	**8**	16,607	**34**	6	787
3A	**9**	2,962	**19**	5	515
5D	**10**	9,651	**17**	38	441
4A	**11**	2,368	**12**	5	401
3B	**12**	2,566	**9**	5	1,259
4B		7,911	**25**	n/a	501

Ranking by Lead Microvac Result

Unit	Rank	Asbestos Wipe	Lead Wipe	Lead Microvac	MMVF Wipe
5C	**1**	35,021	129	**177**	687
4C	**2**	14,242	88	**75**	477
3C	**3**	34,030	268	**72**	477
4D	**4**	8,861	52	**61**	830
5D	**5**	9,651	17	**38**	441
3D	**6**	60,623	81	**20**	601
2A	**7**	16,607	34	**6**	787
3A	**8**	2,962	19	**5**	515
3B	**9**	2,566	9	**5**	1,259
4A	**10**	2,368	12	**5**	401
2B	**11**	28,092	40	**3**	4,731
5A	**12**	65,290	732	**2**	799
4B		7,911	25	**N/A**	501

[21] The results for each compound and/or sample type were averaged by unit and then ranked from the highest concentration to the lowest concentration. The values presented in the tables represent the average concentration detected per unit. The average concentration calculation included samples that were identified as below the detection limit. These samples were assigned a value equal to the detection limit. The sample size for each unit was generally either four or five samples. Unit 4B was not included in the rankings because no micro vacuum samples were collected for lead before cleaning.

Table 10.0
Ranking of Residential Units by
Pre-Cleaning Average Concentrations of Contaminants[22]

Unit Number	*Observable Dust*	*Cleaning Test*	*Times Cleaned*	*Presence of Belongings*[23]	*Asbestos Wipe*	*Lead Wipe*	*Lead Microvac*	*MMVF Wipe*	*Sum of Ranks*
					Rank	**Rank**	**Rank**	**Rank**	
5C	significant	3A,3A,3B	3	No, 1 couch	3	3	1	6	**13**
5A	minimal	3B,3B	2	No, 1 couch	1	1	12	4	**18**
3C	significant	1A,1A,3B	3	No, 1 couch	4	2	3	9	**18**
3D	significant	1A,1A	2	no, 1 couch & chair	2	5	6	7	**20**
4D	significant	2A,2A	2	no, 1 chair & ottoman	9	6	4	3	**22**
4C	significant	1A	1	no, 1 couch	7	4	2	10	**23**
2B	minimal	3A	1	no, 1 couch	5	7	11	1	**24**
2A	minimal	1B,1B	2	no, 1 couch & chair	6	8	7	5	**26**
5D	significant	3B	1	no, 1 couch	8	10	5	11	**34**
3B	minimal	Scope A	2	Yes	11	12	9	2	**34**
3A	minimal	2B	1	yes, carpet	10	9	8	8	**35**
4A	minimal	2A,2A	2	no, 1 couch	12	11	10	12	45

Cleaning Equipment:
1A Basic w/o AFD
2A Intermediate w/HEPA w/o AFD
3A Advanced w/o AFD
1B Basic w/AFD
2B Intermediate w/HEPA w/AFD
3B Advanced w/AFD

The visual classification of dust in the apartments was also compared to the ranking for each apartment. There was general agreement between the visual observations and the analytical results in that five of the six units that were classified as having significant dust accumulation ranked in the top six places. This indicates that visual observations of dust is an indicator that contaminants associated with WTC-related dust may be present.

[22]Each contaminant per sampling type was ranked based upon the average concentration per unit with the highest average concentration receiving a rank of 1 and the remaining values continued in ascending order up to 12. The ranking for each combination was then summed for each unit to determine which unit had the highest overall concentration of contaminants. The sum of the rankings for each compound per unit indicates that 5C contained the highest concentrations of contaminants prior to cleaning. Note that the lower the sum of ranks, the higher the concentration of total contaminants.

Unit 4B is not included in the list of rankings because there were no lead micro vacuum samples collected in this unit. As a point of reference, the sum of the ranks for 4B for the asbestos, lead, and MMVF wipe samples totals 27. This indicates that this unit would have placed in the bottom-tier of the rankings.

[23]In units where personal belongings were retained, the items were cleaned and bagged, simulating a situation where no belongings were present.

2.
The study found that the observation of WTC dust is an indicator that WTC contaminants may be present and that the amount of WTC dust correlates with the level of contamination.

5.3 Location of Units

Based upon the visual observations of dust and the ranking of individual apartments for pre-cleaning analytical results, it was noted that the apartments facing the WTC site corresponded with a higher average level of contamination within the unit for lead, asbestos and MMVF. Specifically, the units facing Liberty Street (units with C and D designations) which were in the direct path of the WTC collapse generally showed the greatest degree of contamination. This indicates that buildings, or portions of buildings, that had significant amounts of dust deposited from the WTC site may have had a greater amount of contamination than buildings that did not have significant amounts of dust deposited.

3.
The study found that the portions of the building with higher levels of deposited WTC dust had higher levels of contamination.

5.4 Comparison to Health-Based Benchmarks

The pre-cleaning analytical results for all of the data sets listed above were also evaluated to determine if the concentration of contaminants in the dust were elevated above health-based benchmarks. For this evaluation, the health-based benchmarks presented in Table 1.0 were used for comparison to the pre-cleaning and post-cleaning sampling results. Based on pre-cleaning data, there were ten residential units and five commercial units that exceeded a health-based benchmark for either lead, dioxin, PAH, or some combination of the three compounds. Based on post-cleaning data, an additional three residential units and one common area exceeded a health-based benchmark for either asbestos, lead, MMVF, or alpha-quartz, or a combination of these compounds.

Cumulatively, nineteen sites inside the building or 76 percent exceeded a health-based benchmark for one or more contaminants associated with the WTC collapse. This indicates that some contaminant concentrations exceeded health-based benchmarks.

4.
The study found that concentrations of some contaminants in the WTC dust were elevated above health-based benchmarks.

5.5 Cleaning Effectiveness

Cleaning effectiveness was determined using two endpoints. One endpoint was the reduction in contaminant concentration between the pre-cleaning and post-cleaning event concentrations in each unit. The other endpoint was the ability to meet health-based benchmarks. The evaluation of both endpoints proved that cleaning indoor environments using standard cleaning techniques (vacuuming and wet wiping techniques) succeeded in reducing contaminant concentrations below health-based benchmarks. This is evidenced by the fact that all residential units, commercial units, and common areas had marked reductions in contaminant concentrations between cleaning events. In addition, all of the residential units, commercial units, and common areas exhibited concentrations that were below health-based benchmarks at the conclusion of the study.

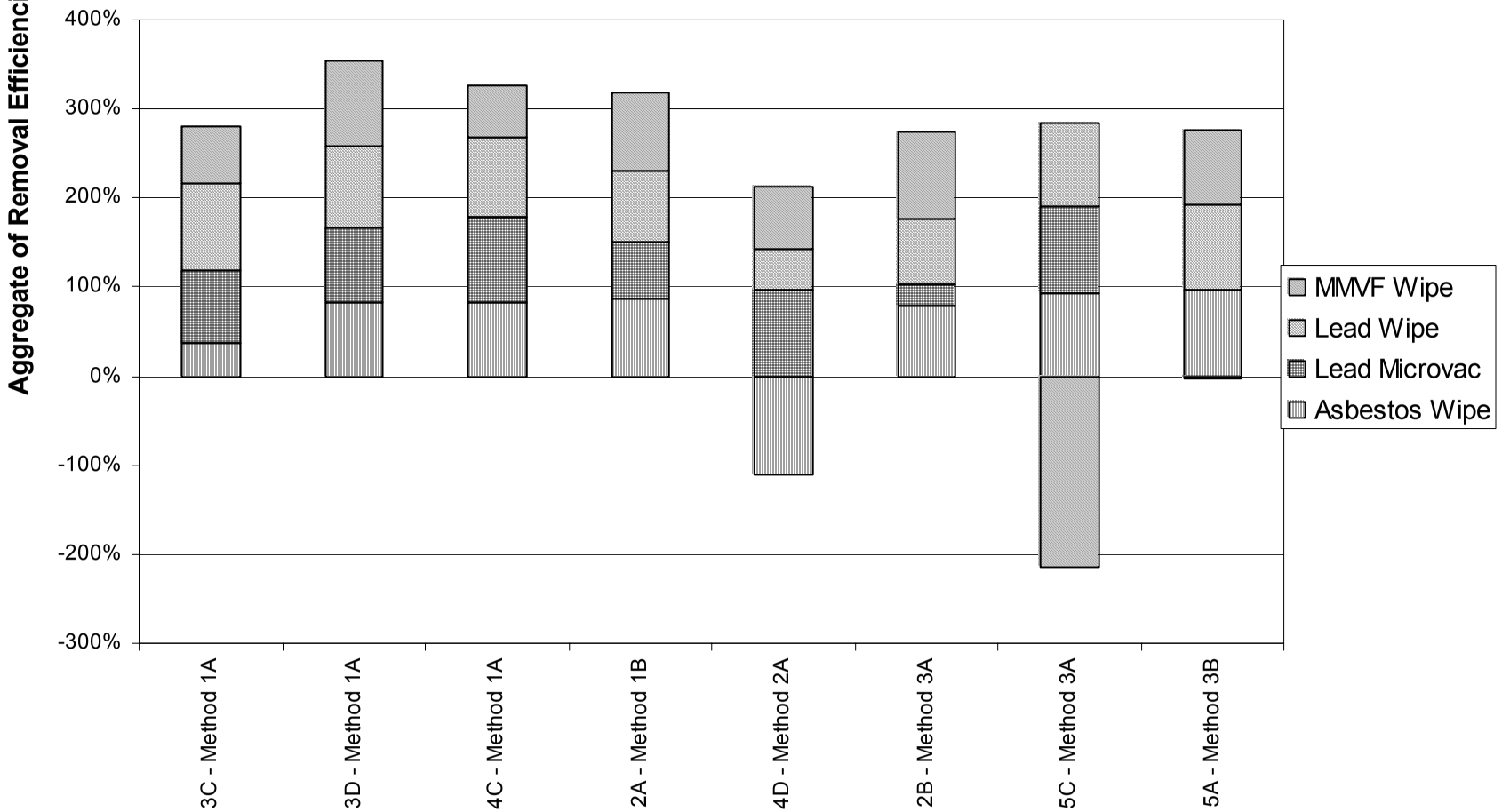
The comparison of pre-cleaning and post-first cleaning concentrations for asbestos wipe and air samples, lead wipe and micro vacuum samples, MMVF wipe samples, and asbestos air samples from post-second and third cleaning events is presented in Table 11.l. This table shows the average concentration of the pre-cleaning samples in comparison with post-cleaning events, with the difference presented in the last column on the right. Exceedances of COPC by cleaning event are presented in Table 11.2. *Note: Due to the quantity of information presented, Table 11.1 and Table 11.2 are presented at the conclusion of this discussion.*

The aggregate removal efficiencies for the nine apartments that were identified as being the most heavily contaminated, based on pre-cleaning results, are presented in Figure 1.0. This figure shows that with the exception of two apartments, there was a net decrease for each contaminant regardless of sampling media or test methods. Asbestos wipe samples for one apartment and MMVF wipe samples for another apartment were the two exceptions. The reason for this is unknown.

As indicated in Section 2.4, a total of eleven cleaning methods were tested in the study. These eleven methods were distributed among 25 spaces, although one of the methods, 4A, was used in all of the common spaces and commercial spaces. Because the different test methods that were evaluated were similar in nature, and the number of apartments that were available for testing the methods was limited, all of the test methods were identified as being able to reduce contaminant concentrations and no specific test method was identified as being more effective. Therefore, the central theme of these methods, specifically vacuuming and using wet wiping techniques, was demonstrated to be effective for reducing contaminant concentrations.

5.
The study demonstrated that use of a standard cleaning method of vacuuming and wet wiping significantly reduced levels of WTC-related contamination with each cleaning event and was successful in reducing concentrations to levels below health-based benchmarks.

Figure 1.0 Contaminant Removal Efficiency After the First Cleaning Attempt of Units Identified Through Pre-Cleaning Measurements as Most Contaminated (2A, 2B, 3C, 3D, 4C, 4D, 5A, and 5C).



5.6 Multiple Cleaning Events

The results indicate that meeting health-based benchmarks is achievable using the methods identified above, although they also indicate that multiple cleaning events (from one to three times) may be needed to achieve these benchmarks. The incremental increase in the number of residential units that met the health-based benchmarks is presented in Table 12.0. The data shows that dioxin and PAH met the health-based benchmarks after the first cleaning for each unit and that the majority of the units (92 percent) met the health-based benchmarks for MMVF and alpha-quartz after the first cleaning. The number of cleaning events required to meet all of the health-based benchmarks for each unit are presented in Table 4.0. This table illustrates that multiple cleaning events may be needed to meet the health-based benchmarks for each compound.

Table 12.0
Number of Units Meeting Health-Based Benchmarks by Cleaning Event

Compound	***Pre-Cleaning***	***First Cleaning***	***Second Cleaning***	***Third Cleaning***
Asbestos	N/A[24]	5/13 (38%)	6/8 (75%)	2/2 (100%)
Lead	3/13 (23%)	9/13 (69%)	4/4 (100%)	
MMVF	N/A	12/13/ (92%)	0/2 (0%)	2/2 (100%)
Alpha-quartz	N/A	12/13 (92%)	1/1 (100%)	
Dioxin	12/13 (92%)	13/13 (100%)		
PAH	10/13 (77%)	13/13 (100%		

An analysis was also conducted to examine if the degree of pre-cleaning contamination affected the number of cleaning events required to meet the health-based benchmarks. Table 13.0 below presents the results of this analysis. The sum of ranks for each apartment from Table 9.0 were grouped and the average number of cleaning events for each grouping was calculated. Since there were no definitive natural breaks in the sum of ranks, three separate groupings were chosen. One was based on a numeric grouping, in which the sum of ranks were assigned to four groups (10-19, 20-29, 30-39, and 40 and above).

The results suggest that there is a decreasing trend in the number of cleaning events required. The second grouping used the mid-point to create two groups (0-23 and 24-48). This grouping also indicates a decreasing trend in the average number of cleaning events required. The third grouping divided the data into an equal number of units. Although this grouping suggests a decreasing trend for most of the groupings, the decreased trend did not continue for the last set of

[24]N/A signifies that samples were not collected before cleaning.

data. Overall, it appears that there may be a decreasing trend in the average number of cleaning events required to meet the clearance criteria based upon the degree of pre-cleaning contamination.

Table 13.0

Residential Units that are More Heavily Contaminated (Lower Sum of Ranks) Required More Cleaning Events to Achieve the Clearance Criteria[25]

Unit Number	*Observable Dust*	*Cleaning Test*	*Times Cleaned*	*Sum of Ranks*	*Numeric Grouping*	*Mid-point Grouping*	*Equal Number Grouping*
5C	significant	3A,3A,3B	3	13			
5A	minimal	3B,3B	2	18	2.7		2.7
3C	significant	1A,1A,3B	3	18		2.2	
3D	significant	1A,1A	2	20			
4D	significant	2A,2A	2	22			1.7
4C	significant	1A	1	23	1.6		
2B	minimal	3A	1	24			
2A	minimal	1B,1B	2	26			1.3
5D	significant	3B	1	34	1.3	1.5	
3B	minimal	Scope A	2	34			
3A	minimal	2B	1	35			1.7
4A	minimal	2A,2A	2	45	N/A		

It should be noted that there were two units in which the test was changed for the third cleaning event. Unit 3C was cleaned twice using Test 1A. Test 3B was used for the third cleaning to achieve the health-based benchmarks. Unit 5C was cleaned twice using Test 3A. Test 3B was used for the third cleaning to achieve the health-based benchmarks. It is unclear if the change in the method, the additional cleaning event, or a combination of the two, was responsible for meeting the health-based benchmark.

6.
The study found that two to three cleanings were necessary to reduce contamination levels to below health-based benchmarks, and that the number of cleanings generally correlated with the levels of contamination initially found in the units.

[25]Using the rankings presented in Table 10.0, a semi-quantitative evaluation was made to determine if there was a difference in the number of cleaning events needed to meet the clearance criteria based on the measured concentrations of pre-cleaning contamination. The average number of cleaning events required to meet the clearance criteria was calculated using several different groupings of the sum of ranks. The first set of calculations used numeric breakpoints of 10-19, 20-29, 30-39, and >40. This grouping indicates a decreasing trend in the average number of cleaning events required. The second set of groupings used the mid-point 23.5. This grouping also indicates a decreasing trend in the average number of cleaning events required. The third grouping divided the data into an equal number of units. Although this grouping suggests a decreasing trend for most of the groupings, the decreased trend did not continue for the last set of data. Overall, it appears that there may be a decreasing trend in the average number of cleaning events required to meet the clearance criteria based upon the degree of pre-cleaning contamination.

5.7 Sampling Methods

Several types of sampling methods (air, micro vacuum, and wipe samples) were used in this study to determine the contaminant concentrations before and after cleaning events. An assessment was made to determine if one of these sampling methods could be used as a surrogate, which would allow only one type of sample for one compound to be used to assess if an indoor space required additional cleaning. As the amount of contamination present after a cleaning event was the most important factor for determining if a surrogate test could be used, only the post-cleaning data was used for this particular assessment.

The post-cleaning data that was collected indicated that it was necessary to conduct eleven additional cleaning events (9 second cleaning events and 2 third cleaning events) due to either a health-based benchmark being exceeded or samples that could not be analyzed. As presented in Table 14.0, air samples collected for asbestos and analyzed using PCMe accounted for the majority (82 percent) of the additional cleaning events. These additional cleaning events were conducted because the filters were overloaded with particulate matter and could not be analyzed. In comparison:

lead would have resulted in a total of four additional cleaning events (36 percent), although three were based on wipe samples and one was based on a micro vacuum sample;
MMVF air samples resulted in three additional cleaning events (27 percent);
silica resulted in one additional cleaning even t(nine percent); and
PAH and dioxin wipe samples results in zero additional cleaning events.

This indicates that the testing methodology associated with PCMe asbestos air sampling is very sensitive to particulate matter and that an indoor environment needs to be relatively clean of particulate matter to achieve valid PCMe results. Based on the compounds and testing methods chosen, the data suggests that using asbestos air samples as an indicator for additional cleaning is the most sensitive of the testing methods, as it results in the largest percentage of additional cleaning events. In addition, it is conservative in nature because the asbestos air sampling with PCMe analysis may indicate that additional cleaning events need to be conducted even if no contamination is present above health-based benchmarks, simply because of excess particulate matter. For example, there were five instances where the sampling results for the other compounds indicated that the unit met the health-based benchmarks, which would indicate that no additional cleaning was necessary; however, because the asbestos air samples could not be analyzed due to the filters being overloaded with particulate material, the unit was cleaned again.

Table 14.0
Number of Additional Cleaning Events Required based on Sampling Method[26]

Compound	*Sampling Method(s)*	*Number of Additional Cleaning Events*	*Percentage*
Total	Air, Micro vacuum and Wipe	11	**100%**
Asbestos	Air via PCMe	9	**82%**
Lead	Wipe	3	**27%**
Lead	Micro vacuum	1	**9%**
MMVF	Air	3	**27%**
Silica	Air	1	**9%**
PAH	Wipe	0	**0%**
Dioxin	Wipe	0	**0%**

Table 14.0 indicates the number of additional cleaning events that were required based on the results from the post-cleaning event samples for the residential units by compound and sampling method. The data indicates that using asbestos air sampling with PCMe analysis accounted for the most number of additional cleaning events. Overall, the data suggest that the use of asbestos air sampling as a surrogate testing method is generally a conservative methodology to use to determine if further cleaning is warranted.

7.
The study found that conducting asbestos in air sampling after cleaning could be used as a surrogate method for determining if future cleaning was needed.

[26]The percentages listed in the right-hand column sum to greater than 100% because several of the units had more than one compound above a health-based benchmark after a cleaning event.

5.8 Air Disturbance

The asbestos air samples were collected using two types of air disturbance prior to sampling. Either an aggressive technique, using a leaf blower and oscillating fans to disturb the air, or a modified-aggressive technique, using only oscillating fans to disturb the air was used. In several instances both methods were used in the same apartment to evaluate if there was a difference in the analytical results. Both the aggressive and modified-aggressive techniques are expected to create air disturbance over an eight-hour sampling period that represents either a worst-case or high-end (respectively) air movement in an indoor environment, which would provide a conservative estimate of the airborne asbestos concentration.

Table 15.0
Comparison of Airborne Asbestos Samples Collected Using Modified-Aggressive and Aggressive Air Disturbance Methods[27]

	Modified-Aggressive Air Disturbance			*Aggressive Air Disturbance*		
Unit	**Sample ID**	**Result**	**Units**	**Sample ID**	**Result**	**Units**
2A	9094-A-2A-25	0.0004	S>5µ/cc	9094-A-2A-28	< 0.0005	S>5µ/cc
	9094-A-2A-26	0.0004	S> 5µ/cc	9094-A-2A-29	< 0.0005	S> 5µ/cc
	9094-A-2A-27	0.0004	S> 5µ/cc	9094-A-2A-30	< 0.0005	S> 5µ/cc
3B	9094-A-3B-39	< 0.0005	S> 5µ/cc			
	9094-A-3B-40	< 0.0005	S> 5µ/cc			
	9094-A-3B-41	< 0.0005	S> 5µ/cc			
3C	9094-A-3C-32	< 0.0005	S> 5µ/cc	9094A-3C-35	< 0.0005	S> 5µ/cc
	9094-A-3C-33	< 0.0005	S> 5µ/cc	9094-A-3C-36	< 0.0005	S> 5µ/cc
	9094-A-3C-34	< 0.0005	S> 5µ/cc	9094-A-3C-37	< 0.0005	S> 5µ/cc
3D	9094-A-3D-23	< 0.0005	S> 5µ/cc	90-94-A-3D-33	< 0.0005	S> 5µ/cc
	9094-A-3D-24	< 0.0005	S> 5µ/cc	9094-A-3D-34	< 0.0005	S> 5µ/cc
5C	9094-A-5C-31	0.0004	S> 5µ/cc	9094-A-5C-33	0.0016	S> 5µ/cc
	9094-A-5C-32	< 0.004	S> 5µ/cc	9094-A-5C-34	0.0015	S> 5µ/cc
Number Below Detection Limit		**9/13**			**8/10**	
Percent Below Detection Limit		**69.2%**			**80.0%**	
Average		**0.00045**			**0.00071**	

In apartments where both methods were used, the modified-aggressive technique was used first and air samples were collected. Several days later, the aggressive technique was used and additional air samples were collected with no cleaning events occurring between sampling events.

[27]Samples below the detection limit were assigned a value equal to the detection limit. Comparison of asbestos air samples that were collected using modified-aggressive and aggressive air disturbance. The samples collected using modified-aggressive air disturbance (i.e., box fans) were collected several days prior to the samples collected using aggressive air disturbance (i.e., leaf blower and box fans). The comparison does not show any trends, as the percentage of samples below the detection limit was higher for the aggressive air disturbance while the average asbestos concentration was nominally lower for the modified-aggressive air disturbance.

As shown in Table 15.0, the comparison of these results suggest that no conclusive difference could be observed.

Overall, the samples collected using the aggressive technique had a slightly higher percentage of samples below the detection limit (80 percent vs. 69 percent) than the samples collected with the modified-aggressive technique, while the samples collected using the modified-aggressive technique had a lower average concentration (0.00045 S/cc) than the samples collected using the aggressive technique (0.00071 S/cc).

8.
The study did not find a measurable difference in the use of modified or aggressive air disturbance technique.

5.9 Filter Overloading

As mentioned above, there were many instances where the filters from the asbestos air samples were overloaded with particulate material and could not be analyzed, which resulted in invalid asbestos air results and required additional cleaning events. During the study, the use of an air filtration device was added to the cleaning method for the third cleaning in an attempt to reduce the airborne particulate matter as both previous air sampling events resulted in overloaded filters. This occurred twice. In both cases, there was no overloading of the filters and valid asbestos air results were received. This prompted an evaluation to determine if there was a noticeable reduction in overloading filters with particulate matter when an AFD was used during the cleaning event. The data for all of the units in the building were used to see if there was a difference in the percentage of units with at least one overloaded filter when an AFD was used.

Table 16.0 presents a comparison of the percentage of units, including residential, common spaces, and commercial spaces, with asbestos air samples that could not be analyzed due to the filter being overloaded with particulate matter, and indicates whether or not an AFD was used. The data suggest that using an AFD during cleaning may offer a slight advantage for reducing the potential for overloading a filter with particulate matter.

9.
The study found that the use of an Air Filtration Device during cleaning offered a slight advantage to reducing the potential for filter overloading.

Table 16.0
The Use of an Air Filtration Device Reduces the Occurrence of Overloaded Air Sample Filters

AFD Used	*Number of Units with or without AFDs for the First cleaning*	*Number of Units with One or More Overloads*	*Percentage of Units with Overloads*
Yes	18	7	38.9%
No	7	4	57.1%
AFD Used	*Number of Units with or without AFDs for the Second Cleaning*	*Number of Units with at Least One Overload*	*Percentage of Units with Overloads*
Yes	5	0	0.05
No	5	2	40.0%
AFD Used	*Number of Units with or without AFDs for the Third Cleaning*	*Number of units w/at Least One Overload*	*Percentage of Units with Overloads*
Yes	2	0	0.0%
No	0	0	N/A

5.10 HVAC System

The HVAC system was cleaned in two of the commercial units. The system was cleaned by professionals using equipment and techniques common to the industry that included HEPA-filtered vacuums, air whips, air washing and soap and water washes. Wipe samples were collected prior to cleaning and after cleaning for comparison. The results indicate that overall there was a reduction of an order of magnitude for the compounds which were detected. In The Food Exchange, lead was reduced from 1,310 $\mu g/m^3$ to 159 $\mu g/m^3$ (average), MMVF was reduced from 11,732 S/cm^2 to<57.3 S/cm^2. In the Lemongrass Grill, there was a reduction in lead concentrations from 10,700 $\mu g/m^3$ to 95.95 $\mu g/m^3$ (average). This indicates that standard HVAC cleaning methods and equipment reduced the concentrations of WTC-related contaminants by an order of magnitude.

10.
The study found that standard HVAC cleaning methods reduced the concentrations of WTC-related contaminants.

5.11 Observations

5.11.1 Review of Personal Monitoring Data

In addition to evaluating the efficiency of various cleaning methods, the study assessed the potential for exposure to workers during the actual cleaning procedures. This was accomplished through the collection of personal monitoring data (approximately 500 samples) while cleaning was taking place. These samples, which measured airborne levels of asbestos, lead and silica, provide insight, although limited by the scope of the pilot program, into the potential exposures incurred by residents during cleaning activities.

All air samples (103) that were analyzed by phase contrast microscopy (PCM) were below the Occupational Health and Safety Administration's (OSHA) Permissible Exposure Limit (PEL) for asbestos of 0.1 f/cc. The PEL represents a time-weighted average over a 40 hour work week, and is intended to protect workers from adverse health effects. Although PCM analysis is the required analytical procedure for compliance with OSHA PEL for asbestos, EPA conducted an additional analysis of samples using transmission electron microscopy (TEM) for all samples that were greater than 1/10 the OSHA PEL (64 samples). This follow up analysis by the more powerful transmission electron microscope determined that very little of the fibrous material identified by PCM was actually asbestos. PCM cannot distinguish asbestos from other non-asbestos fibers (e.g., fibrous glass), whereas TEM has that ability.

Personal air monitoring results (44 samples) for lead were all below the OSHA PEL of 50 $\mu g/m^3$. The PEL represents a time-weighted average over a 40 hour work week, and is intended to protect workers from adverse health effects. No individual sample exceeded 1 $\mu g/m^3$.

Personal air monitoring results (97 samples) for crystalline silica (quartz) were, with one exception, below the OSHA PEL of 100 $\mu g/m^3$. The PEL represents a time-weighted average over a 40 hour work week, and is intended to protect workers from adverse health effects. The quartz concentration in the sample that exceeded the PEL was 108 $\mu g/m^3$. Only 19 of the 96 samples were above the approximate detection limit of 5 $\mu g/m^3$.

Asbestos, lead and crystalline silica (quartz) are substances that have been identified as WTC contaminants of potential concern in the indoor environment. The personal monitoring data obtained during the study, within the range of contamination found in the building's apartments, that the use of personal protective equipment (e.g., respirator, gloves) during cleaning activities (vacuuming, wet wiping) was not necessary.

5.11.2 Final Observations

EPA's position remains that individuals concerned about the presence of WTC-related dust should use HEPA vacuums and wet wiping to remove the dust from their dwelling spaces. Depending on the amount of dust deposited, repeated cleanings may be necessary.

5.12 Complexities

The interpretation of results from this study is complicated by several factors. This was a non-controlled, field study. The WTC dust material is not homogeneous; in EPA's ambient WTC settled dust bulk sampling only 35 percent of the samples contained greater than one percent asbestos. The number of completely or partially uncleaned buildings available and willing to participate in the study was very limited. Thus, in the selected building, units varied in the amount of baseline contamination, and results of baseline testing were not available prior to the assignment and initiation of the first set of cleaning protocols. Therefore, some cleaning methods (Scope A, 1B and 2B) were only tested on units with lower levels of contamination. Therefore, it is difficult to draw conclusions about the ability of these methods to remove heavy contamination. It was not possible to make every comparison between methods and the level of contamination. In addition, a large number of cleaning methods were tested, given the number of units available for pilot cleaning. This limited the number of times each method could be tested, and makes the overall results more susceptible to fluctuations due to extreme data points that may represent rare, unusual conditions. Variation in the types of sampling conducted pre- and post-cleaning events make it difficult to compare certain indices of contamination to different cleaning methods.

6. Summary

This complex study was able to identify a cleaning method that is able to reduce levels of the multiple contaminants that are associated with WTC-related dust and able to reduce those contaminants below health-based benchmarks. The specific cleaning method includes vacuuming porous and hard surfaces and wet wiping hard surfaces. The results also indicate that the cleaning method may need to be repeated several times, especially in heavily impacted apartments, to bring concentrations below health-based benchmarks. In addition, the results from this study indicate that using asbestos air sampling to determine if additional cleaning is necessary is an approach that should generally determine if an area has been cleaned effectively. The data also indicates that buildings that had significant amounts of WTC-related dust are likely to have had more contamination than those buildings that did not have significant amounts of dust deposited.

In conclusion, this study shows that while there were impacts to the indoor environment in this building from the collapse of the WTC, these types of impacts can be mitigated if the cleaning method identified is followed, perhaps several times, and should result in an indoor environment that is similar to those found prior to the collapse.

Table 11.1

Comparison of Cleaning Results by Cleaning Event

Table 11.1

PCME Asbestos Air Samples - Pre 2nd Cleaning, Post 2nd Cleaning, and Post 3rd Cleaning Results

Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Difference
2A-2nd	9094-A-2A-010	Pre 2nd cleaning		overload	S>5u/cc	2A	9094-A-2A-028	Test 1B - Post 2nd cleaning	<	0.000500	S>5u/cc	
2A-2nd	9094-A-2A-011	Pre 2nd cleaning		overload	S>5u/cc	2A	9094-A-2A-029	Test 1B - Post 2nd cleaning	<	0.000500	S>5u/cc	
2A-2nd	9094-A-2A-012	Pre 2nd cleaning		overload	S>5u/cc	2A	9094-A-2A-030	Test 1B - Post 2nd cleaning	<	0.000500	S>5u/cc	
						2A		Test 1B - Post 2nd cleaning				
						2A		Test 1B - Post 2nd cleaning				
		Average						**Average**		**0.000500**		
3B-2nd	9094-A-3B-011	Pre 2nd cleaning		overload	S>5u/cc	3B	9094-A-3B-039	Scope A - Post 2nd cleaning	<	0.000500	S>5u/cc	
3B-2nd	9094-A-3B-012	Pre 2nd cleaning		overload	S>5u/cc	3B	9094-A-3B-040	Scope A - Post 2nd cleaning	<	0.000500	S>5u/cc	
3B-2nd	9094-A-3B-013	Pre 2nd cleaning		overload	S>5u/cc	3B	9094-A-3B-041	Scope A - Post 2nd cleaning	<	0.000500	S>5u/cc	
3B-2nd	9094-A-3B-026	Pre 2nd cleaning	<	0.000900	S>5u/cc	3B		Scope A - Post 2nd cleaning				
3B-2nd	9094-A-3B-027	Pre 2nd cleaning		0.001100	S>5u/cc	3B		Scope A - Post 2nd cleaning				
3B-2nd	9094-A-3B-028	Pre 2nd cleaning	<	0.000500	S>5u/cc	3B		Scope A - Post 2nd cleaning				
3B-2nd	9094-A-3B-029	Pre 2nd cleaning		0.000500	S>5u/cc	3B		Scope A - Post 2nd cleaning				
3B-2nd	9094-A-3B-030	Pre 2nd cleaning	<	0.000500	S>5u/cc	3B		Scope A - Post 2nd cleaning				
3B-2nd	9094-A-3B-031	Pre 2nd cleaning		0.001500	S>5u/cc	3B		Scope A - Post 2nd cleaning				
3B-2nd	9094-A-3B-032	Pre 2nd cleaning		0.001100	S>5u/cc	3B		Scope A - Post 2nd cleaning				
3B-2nd	9094-A-3B-033	Pre 2nd cleaning		0.000900	S>5u/cc	3B		Scope A - Post 2nd cleaning				
3B-2nd	9094-A-3B-034	Pre 2nd cleaning	<	0.000500	S>5u/cc	3B		Scope A - Post 2nd cleaning				
3B-2nd	9094-A-3B-035	Pre 2nd cleaning		0.001000	S>5u/cc	3B		Scope A - Post 2nd cleaning				
3B-2nd	9094-A-3B-036	Pre 2nd cleaning	<	0.000900	S>5u/cc	3B		Scope A - Post 2nd cleaning				
						3B		Scope A - Post 2nd cleaning				
		Average		**0.000855**				**Average**		**0.000500**		
3C-2nd	9094-A-3C-009	Pre 2nd cleaning		overload	S>5u/cc	3C	9094-A-3C-025	Test 1A - Post 2nd cleaning		overload	S>5u/cc	
3C-2nd	9094-A-3C-010	Pre 2nd cleaning		overload	S>5u/cc	3C	9094-A-3C-026	Test 1A - Post 2nd cleaning		overload	S>5u/cc	
3C-2nd	9094-A-3C-011	Pre 2nd cleaning		overload	S>5u/cc	3C	9094-A-3C-027	Test 1A - Post 2nd cleaning		overload	S>5u/cc	
						3C	9094-A-3C-028	Test 1A - Post 2nd cleaning		overload	S>5u/cc	
						3C	9094-A-3C-029	Test 1A - Post 2nd cleaning		overload	S>5u/cc	
		Average						**Average**				
3C-3rd	9094-A-3C-025	Post 2nd cleaning - Test 1A		overload	S>5u/cc	3C	9094-A-3C-032	Test 3B - Post 3rd cleaning	<	0.0005	S>5u/cc	
3C-3rd	9094-A-3C-026	Post 2nd cleaning - Test 1A		overload	S>5u/cc	3C	9094-A-3C-033	Test 3B - Post 3rd cleaning	<	0.0005	S>5u/cc	
3C-3rd	9094-A-3C-027	Post 2nd cleaning - Test 1A		overload	S>5u/cc	3C	9094-A-3C-034	Test 3B - Post 3rd cleaning	<	0.0005	S>5u/cc	
3C-3rd	9094-A-3C-028	Post 2nd cleaning - Test 1A		overload	S>5u/cc	3C	9094-A-3C-035	Test 3B - Post 3rd cleaning	<	0.0005	S>5u/cc	
3C-3rd	9094-A-3C-029	Post 2nd cleaning - Test 1A		overload	S>5u/cc	3C	9094-A-3C-036	Test 3B - Post 3rd cleaning	<	0.0005	S>5u/cc	
						3C	9094-A-3C-037	Test 3B - Post 3rd cleaning	<	0.0005	S>5u/cc	
		Average						**Average**		**0.000500**		
3D-2nd	9094-A-3D-008	Pre 2nd cleaning		overload	S>5u/cc	3D	9094-A-3D-023	Test 1A - Post 2nd cleaning	<	0.0005	S>5u/cc	
3D-2nd	9094-A-3D-009	Pre 2nd cleaning		overload	S>5u/cc	3D	9094-A-3D-024	Test 1A - Post 2nd cleaning	<	0.0004	S>5u/cc	
3D-2nd	9094-A-3D-010	Pre 2nd cleaning		overload	S>5u/cc	3D	9094-A-3D-025	Test 1A - Post 2nd cleaning	<	0.0005	S>5u/cc	
						3D	9094-A-3D-026	Test 1A - Post 2nd cleaning	<	0.0005	S>5u/cc	
		Average						**Average**		**0.000475**		
4A-2nd	9094-A-4A-008	Pre 2nd cleaning		overload	S>5u/cc	4A	9094-A-4A-023	Test 2A - Post 2nd cleaning	<	0.0009	S>5u/cc	
4A-2nd	9094-A-4A-009	Pre 2nd cleaning		overload	S>5u/cc	4A	9094-A-4A-024	Test 2A - Post 2nd cleaning	<	0.0008	S>5u/cc	
4A-2nd	9094-A-4A-010	Pre 2nd cleaning		overload	S>5u/cc	4A	9094-A-4A-025	Test 2A - Post 2nd cleaning	<	0.0009	S>5u/cc	
		Average						**Average**		**0.000867**		
5C-2nd	9094-A-5C-009	Pre 2nd cleaning		overload	S>5u/cc	5C	9094-A-5C-024	Test 3A - Post 2nd cleaning		overload	S>5u/cc	

Table 11.1

PCME Asbestos Air Samples - Pre 2nd Cleaning, Post 2nd Cleaning, and Post 3rd Cleaning Results

Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Difference
5C-2nd	9094-A-5C-010	Pre 2nd cleaning		overload	S>5u/cc	5C	9094-A-5C-025	Test 3A - Post 2nd cleaning		overload	S>5u/cc	
5C-2nd	9094-A-5C-011	Pre 2nd cleaning		overload	S>5u/cc	5C	9094-A-5C-026	Test 3A - Post 2nd cleaning		overload	S>5u/cc	
						5C	9094-A-5C-027	Test 3A - Post 2nd cleaning		overload	S>5u/cc	
						5C	9094-A-5C-028	Test 3A - Post 2nd cleaning		overload	S>5u/cc	
		Average						**Average**				
5C-3rd	9094-A-5C-024	Post 2nd cleaning - Test 3A		overload	S>5u/cc	5C	9094-A-5C-031	Test 3B - Post 3rd cleaning		0.0004	S>5u/cc	
5C-3rd	9094-A-5C-025	Post 2nd cleaning - Test 3A		overload	S>5u/cc	5C	9094-A-5C-032	Test 3B - Post 3rd cleaning	<	0.0004	S>5u/cc	
5C-3rd	9094-A-5C-026	Post 2nd cleaning - Test 3A		overload	S>5u/cc	5C	9094-A-5C-033	Test 3B - Post 3rd cleaning		0.0016	S>5u/cc	
5C-3rd	9094-A-5C-027	Post 2nd cleaning - Test 3A		overload	S>5u/cc	5C	9094-A-5C-034	Test 3B - Post 3rd cleaning		0.0015	S>5u/cc	
5C-3rd	9094-A-5C-028	Post 2nd cleaning - Test 3A		overload	S>5u/cc	5C						
		Average						**Average**		**0.000975**		

Table 11.1
Lead Wipe Samples - Before Cleaning and Post 1st Cleaning Results

Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Difference
2A	9094-W-2A-002	Before cleaning	<	4.65	ug/ft2	2A	9094-W-2A-018	Post 1st cleaning - Test 1B	<	4.65	ug/ft2	
2A	9094-W-2A-003	Before cleaning		49.40	ug/ft2	2A	9094-W-2A-019	Post 1st cleaning - Test 1B		11.30	ug/ft2	
2A	9094-W-2A-004	Before cleaning		35.40	ug/ft2	2A	9094-W-2A-020	Post 1st cleaning - Test 1B	<	4.65	ug/ft2	
2A	9094-W-2A-005	Before cleaning		44.60	ug/ft2	2A	9094-W-2A-021	Post 1st cleaning - Test 1B	<	4.65	ug/ft2	
		Average		**33.51**				**Average**		**6.31**		**27**
2B	9094-W-2B-002	Before cleaning	<	4.65	ug/ft2	2B	9094-W-2B-016	Post 1st cleaning - Test 3A	<	4.65	ug/ft2	
2B	9094-W-2B-003	Before cleaning		97.00	ug/ft2	2B	9094-W-2B-017	Post 1st cleaning - Test 3A		9.90	ug/ft2	
2B	9094-W-2B-004	Before cleaning		17.50	ug/ft2	2B	9094-W-2B-018	Post 1st cleaning - Test 3A		18.70	ug/ft2	
						2B	9094-W-2B-019	Post 1st cleaning - Test 3A		7.41	ug/ft2	
		Average		**39.72**				**Average**		**10.17**		**30**
3A	9094-W-3A-002	Before cleaning	<	4.65	ug/ft2	3A	9094-W-3A-018	Post 1st cleaning - Test 2B	<	4.65	ug/ft2	
3A	9094-W-3A-003	Before cleaning		38.90	ug/ft2	3A	9094-W-3A-019	Post 1st cleaning - Test 2B		10.50	ug/ft2	
3A	9094-W-3A-004	Before cleaning		12.00	ug/ft2	3A	9094-W-3A-020	Post 1st cleaning - Test 2B		9.29	ug/ft2	
						3A	9094-W-3A-021	Post 1st cleaning - Test 2B	<	4.65	ug/ft2	
		Average		**18.52**				**Average**		**7.27**		**11**
3B	9094-W-3B-002	Before cleaning	<	4.65	ug/ft2	3B	9094-W-3B-019	Post 1st cleaning - Scope A	<	4.65	ug/ft2	
3B	9094-W-3B-003	Before cleaning		11.50	ug/ft2	3B	9094-W-3B-020	Post 1st cleaning - Scope A		51.60	ug/ft2	
3B	9094-W-3B-004	Before cleaning		9.65	ug/ft2	3B	9094-W-3B-021	Post 1st cleaning - Scope A		10.90	ug/ft2	
3B	9094-W-3B-005	Before cleaning		LOST	ug/ft2	3B	9094-W-3B-022	Post 1st cleaning - Scope A		7.27	ug/ft2	
		Average		**8.60**				**Average**		**18.61**		**-10**
3C	9094-W-3C-002	Before cleaning	<	4.65	ug/ft2	3C	9094-W-3C-017	Post 1st cleaning - Test 1A		5.02	ug/ft2	
3C	9094-W-3C-003	Before cleaning		750.00	ug/ft2	3C	9094-W-3C-018	Post 1st cleaning - Test 1A		8.03	ug/ft2	
3C	9094-W-3C-004	Before cleaning		48.70	ug/ft2	3C	9094-W-3C-019	Post 1st cleaning - Test 1A		6.01	ug/ft2	
						3C	9094-W-3C-020	Post 1st cleaning - Test 1A	<	4.65	ug/ft2	
		Average		**267.78**				**Average**		**5.93**		**262**
3D	9094-W-3D-002	Before cleaning	<	4.65	ug/ft2	3D	9094-W-3D-016	Post 1st cleaning - Test 1A		8.22	ug/ft2	
3D	9094-W-3D-003	Before cleaning		201.00	ug/ft2	3D	9094-W-3D-017	Post 1st cleaning - Test 1A		9.80	ug/ft2	
3D	9094-W-3D-004	Before cleaning		112.00	ug/ft2	3D	9094-W-3D-018	Post 1st cleaning - Test 1A	<	4.65	ug/ft2	
3D	9094-W-3D-005	Before cleaning	<	4.65	ug/ft2	3D	9094-W-3D-019	Post 1st cleaning - Test 1A	<	4.65	ug/ft2	
		Average		**80.58**				**Average**		**6.83**		**74**
4A	9094-W-4A-002	Before cleaning		5.66	ug/ft2	4A	9094-W-4A-016	Post 1st cleaning - Test 2A	<	4.65	ug/ft2	
4A	9094-W-4A-003	Before cleaning		21.50	ug/ft2	4A	9094-W-4A-017	Post 1st cleaning - Test 2A		10.70	ug/ft2	
4A	9094-W-4A-004	Before cleaning		9.41	ug/ft2	4A	9094-W-4A-018	Post 1st cleaning - Test 2A	<	4.65	ug/ft2	
						4A	9094-W-4A-019	Post 1st cleaning - Test 2A	<	4.65	ug/ft2	
		Average		**12.19**				**Average**		**6.16**		**6**
4B	9094-W-4B-002	Before cleaning	<	4.65	ug/ft2	4B	9094-W-4B-014	Post 1st cleaning - Test 2B	<	4.65	ug/ft2	

Table 11.1
Lead Wipe Samples - Before Cleaning and Post 1st Cleaning Results

Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Difference
4B	9094-W-4B-003	Before cleaning		50.00	ug/ft2	4B	9094-W-4B-015	Post 1st cleaning - Test 2B		6.68	ug/ft2	
4B	9094-W-4B-004	Before cleaning		14.00	ug/ft2	4B	9094-W-4B-016	Post 1st cleaning - Test 2B	<	4.65	ug/ft2	
4B	9094-W-4B-005	Before cleaning		30.00	ug/ft2	4B	9094-W-4B-017	Post 1st cleaning - Test 2B	<	4.65	ug/ft2	
						4B						
		Average		**24.66**				**Average**		**5.16**		**20**
4C	9094-W-4C-002	Before cleaning	<	4.65	ug/ft2	4C	9094-W-4C-019	Post 1st cleaning - Test 1A		LOST	ug/ft2	
4C	9094-W-4C-003	Before cleaning		181.00	ug/ft2	4C	9094-W-4C-020	Post 1st cleaning - Test 1A		14.90	ug/ft2	(Validation = R).
4C	9094-W-4C-004	Before cleaning		77.50	ug/ft2	4C	9094-W-4C-021	Post 1st cleaning - Test 1A		8.28	ug/ft2	(Validation = R).
						4C	9094-W-4C-022	Post 1st cleaning - Test 1A		7.81	ug/ft2	(Validation = R).
		Average		**87.72**				**Average**		**10.33**		**77**
4D	9094-W-4D-002	Before cleaning	<	4.65	ug/ft2	4D	9094-W-4D-020	Post 1st cleaning - Test 2A		20.40	ug/ft2	(Validation = R).
4D	9094-W-4D-003	Before cleaning		169.00	ug/ft2	4D	9094-W-4D-021	Post 1st cleaning - Test 2A		66.00	ug/ft2	(Validation = R).
4D	9094-W-4D-004	Before cleaning		17.40	ug/ft2	4D	9094-W-4D-022	Post 1st cleaning - Test 2A		10.60	ug/ft2	(Validation = R).
4D	9094-W-4D-005	Before cleaning		17.10	ug/ft2	4D	9094-W-4D-023	Post 1st cleaning - Test 2A		15.60	ug/ft2	(Validation = R).
		Average		**52.04**				**Average**		**28.15**		**24**
5A	9094-W-5A-002	Before cleaning		4.79	ug/ft2	5A	9094-W-5A-020	Post 1st cleaning - Test 3B	<	4.65	ug/ft2	
5A	9094-W-5A-003	Before cleaning		191.00	ug/ft2	5A	9094-W-5A-021	Post 1st cleaning - Test 3B		43.50	ug/ft2	
5A	9094-W-5A-004	Before cleaning		2000.00	ug/ft2	5A	9094-W-5A-022	Post 1st cleaning - Test 3B		10.50	ug/ft2	
						5A	9094-W-5A-023	Post 1st cleaning - Test 3B		39.70	ug/ft2	
		Average		**731.93**				**Average**		**24.59**		**707**
5C	9094-W-5C-002	Before cleaning		6.95	ug/ft2	5C	9094-W-5C-017	Post 1st cleaning - Test 3A		Broken	ug/m2	
5C	9094-W-5C-003	Before cleaning		336.00	ug/ft2	5C	9094-W-5C-018	Post 1st cleaning - Test 3A		10.30	ug/ft2	
5C	9094-W-5C-004	Before cleaning		43.60	ug/ft2	5C	9094-W-5C-019	Post 1st cleaning - Test 3A		7.69	ug/ft2	
						5C	9094-W-5C-020	Post 1st cleaning - Test 3A		6.86	ug/ft2	
		Average		**128.85**				**Average**		**8.28**		**121**
5D	9094-W-5D-002	Before cleaning		7.35	ug/ft2	5D	9094-W-5D-016	Post 1st cleaning - Test 3B	<	4.65	ug/ft2	
5D	9094-W-5D-003	Before cleaning		4.68	ug/ft2	5D	9094-W-5D-017	Post 1st cleaning - Test 3B		12.80	ug/ft2	
5D	9094-W-5D-004	Before cleaning		25.30	ug/ft2	5D	9094-W-5D-018	Post 1st cleaning - Test 3B	<	4.65	ug/ft2	
5D	9094-W-5D-005	Before cleaning		32.10	ug/ft2	5D	9094-W-5D-019	Post 1st cleaning - Test 3B	<	4.65	ug/ft2	
		Average		**17.36**				**Average**		**6.69**		**11**

Table 11.1
Lead Micro Vacuum Samples - Before Cleaning and Post 1st Cleaning Results

Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Difference
2A	9094-M-2A-006	Before cleaning		4.03	ug/ft2	2A	9094-M-2A-022	Post 1st cleaning - Test 1B	<	2.32	ug/ft2	
2A	9094-M-2A-007	Before cleaning		14.40	ug/ft2	2A	9094-M-2A-023	Post 1st cleaning - Test 1B	<	2.32	ug/ft2	
2A	9094-M-2A-008	Before cleaning		3.89	ug/ft2	2A	9094-M-2A-024	Post 1st cleaning - Test 1B	<	2.32	ug/ft2	
2A	9094-M-2A-009	Before cleaning	<	2.32	ug/ft2							
		Average		**6.16**				**Average**		**2.32**		**4**
2B	9094-M-2B-005	Before cleaning	<	2.32	ug/ft2	2B	9094-M-2B-020	Post 1st cleaning - Test 3A	<	2.32	ug/ft2	
2B	9094-M-2B-006	Before cleaning		4.54	ug/ft2	2B	9094-M-2B-021	Post 1st cleaning - Test 3A	<	2.32	ug/ft2	
2B	9094-M-2B-007	Before cleaning	<	2.32	ug/ft2	2B	9094-M-2B-022	Post 1st cleaning - Test 3A	<	2.32	ug/ft2	
						2B	9094-M-2B-023	Post 1st cleaning - Test 3A	<	2.32	ug/ft2	
		Average		**3.06**				**Average**		**2.32**		**1**
3A	9094-M-3A-006	Before cleaning	<	4.65	ug/ft2	3A	9094-M-3A-022	Post 1st cleaning - Test 2B		4.85	ug/ft2	
3A	9094-M-3A-007	Before cleaning	<	4.65	ug/ft2	3A	9094-M-3A-023	Post 1st cleaning - Test 2B	<	2.32	ug/ft2	
3A	9094-M-3A-008	Before cleaning	<	4.65	ug/ft2	3A	9094-M-3A-024	Post 1st cleaning - Test 2B		4.39	ug/ft2	
3A	9094-M-3A-009	Before cleaning	<	4.65	ug/ft2	3A	9094-M-3A-025	Post 1st cleaning - Test 2B	<	2.32	ug/ft2	
		Average		**4.65**				**Average**		**3.47**		**1**
3B	9094-M-3B-006	Before cleaning	<	4.65	ug/ft2	3B	9094-M-3B-023	Post 1st cleaning - Scope A	<	2.32	ug/ft2	
3B	9094-M-3B-007	Before cleaning	<	4.65	ug/ft2	3B	9094-M-3B-024	Post 1st cleaning - Scope A	<	2.32	ug/ft2	
3B	9094-M-3B-008	Before cleaning	<	4.65	ug/ft2	3B	9094-M-3B-025	Post 1st cleaning - Scope A	<	2.32	ug/ft2	
		Average		**4.65**				**Average**		**2.32**		**2**
				.								
3C	9094-M-3C-005	Before cleaning		68.40	ug/ft2	3C	9094-M-3C-021	Post 1st cleaning - Test 1A		6.32	ug/ft2	
3C	9094-M-3C-006	Before cleaning		135.00	ug/ft2	3C	9094-M-3C-022	Post 1st cleaning - Test 1A		9.66	ug/ft2	
3C	9094-M-3C-007	Before cleaning		43.30	ug/ft2	3C	9094-M-3C-023	Post 1st cleaning - Test 1A		26.90	ug/ft2	
3C	9094-M-3C-008	Before cleaning		39.40	ug/ft2	3C	9094-M-3C-024	Post 1st cleaning - Test 1A		6.47	ug/ft2	
						3C		Post 1st cleaning - Test 1A				
		Average		**71.53**				**Average**		**12.34**		**59**
3D	9094-M-3D-005	Before cleaning		50.70	ug/ft2	3D	9094-M-3D-020	Post 1st cleaning - Test 1A	<	2.32	ug/ft2	
3D	9094-M-3D-006	Before cleaning	<	4.65	ug/ft2	3D	9094-M-3D-021	Post 1st cleaning - Test 1A		5.71	ug/ft2	(Validation = R).
3D	9094-M-3D-007	Before cleaning	<	4.65	ug/ft2	3D	9094-M-3D-022	Post 1st cleaning - Test 1A	<	2.32	ug/ft2	
		Average		**20.00**				**Average**		**3.45**		**17**
4A	9094-M-4A-005	Before cleaning	<	4.65	ug/ft2	4A	9094-M-4A-020	Post 1st cleaning - Test 2A	<	2.32	ug/ft2	
4A	9094-M-4A-006	Before cleaning	<	4.65	ug/ft2	4A	9094-M-4A-021	Post 1st cleaning - Test 2A	<	2.32	ug/ft2	
4A	9094-M-4A-007	Before cleaning	<	4.65	ug/ft2	4A	9094-M-4A-022	Post 1st cleaning - Test 2A		2.58	ug/ft2	
		Average		**4.65**				**Average**		**2.41**		**2**
4B		Before cleaning				4B		Post 1st cleaning - Test 2B				

Table 11.1
Lead Micro Vacuum Samples - Before Cleaning and Post 1st Cleaning Results

Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Difference
4B		Before cleaning				4B		Post 1st cleaning - Test 2B				
4B		Before cleaning				4B		Post 1st cleaning - Test 2B				
4B		Before cleaning				4B		Post 1st cleaning - Test 2B				
4B		Before cleaning				4B		Post 1st cleaning - Test 2B				
		Average		**none**				**Average**		**none**		
4C	9094-M-4C-005	Before cleaning		76.10	ug/ft2	4C	9094-M-4C-023	Post 1st cleaning - Test 1A	<	2.32	ug/ft2	
4C	9094-M-4C-006	Before cleaning		83.70	ug/ft2	4C	9094-M-4C-024	Post 1st cleaning - Test 1A	<	2.32	ug/ft2	
4C	9094-M-4C-007	Before cleaning		69.80	ug/ft2	4C	9094-M-4C-025	Post 1st cleaning - Test 1A	<	2.32	ug/ft2	
4C	9094-M-4C-008	Before cleaning		70.80	ug/ft2							
		Average		**75.10**				**Average**		**2.32**		**73**
4D	9094-M-4D-006	Before cleaning		83.50	ug/ft2	4D	9094-M-4D-024	Post 1st cleaning - Test 2A		2.40	ug/ft2	
4D	9094-M-4D-007	Before cleaning		66.00	ug/ft2	4D	9094-M-4D-025	Post 1st cleaning - Test 2A	<	2.32	ug/ft2	
4D	9094-M-4D-008	Before cleaning		26.20	ug/ft2	4D	9094-M-4D-026	Post 1st cleaning - Test 2A	<	2.32	ug/ft2	
4D	9094-M-4D-009	Before cleaning		39.90	ug/ft2	4D	9094-M-4D-027	Post 1st cleaning - Test 2A	<	2.32	ug/ft2	
4D	9094-M-4D-010	Before cleaning		78.20	ug/ft2	4D	9094-M-4D-028	Post 1st cleaning - Test 2A	<	2.32	ug/ft2	
4D	9094-M-4D-011	Before cleaning		72.10	ug/ft2	4D	9094-M-4D-029	Post 1st cleaning - Test 2A	<	2.32	ug/ft2	
		Average		**60.98**				**Average**		**2.33**		**59**
5A	9094-M-5A-005	Before cleaning	<	2.23	ug/ft2	5A	9094-M-5A-024	Post 1st cleaning - Test 3B		2.60	ug/ft2	G.F. AA
5A	9094-M-5A-006	Before cleaning	<	2.23	ug/ft2	5A	9094-M-5A-025	Post 1st cleaning - Test 3B		4.15	ug/ft2	G.F. AA
5A	9094-M-5A-007	Before cleaning	<	2.23	ug/ft2	5A	9094-M-5A-026	Post 1st cleaning - Test 3B		2.60	ug/ft2	G.F. AA
5A	9094-M-5A-008	Before cleaning	<	2.23	ug/ft2	5A	9094-M-5A-027	Post 1st cleaning - Test 3B		0.78	ug/ft2	G.F. AA
5A	9094-M-5A-009	Before cleaning	<	2.23	ug/ft2	5A	9094-M-5A-028	Post 1st cleaning - Test 3B		0.98	ug/ft2	G.F. AA
5A	9094-M-5A-010	Before cleaning		3.46	ug/ft2	5A	9094-M-5A-029	Post 1st cleaning - Test 3B		1.02	ug/ft2	G.F. AA
	9094-M-5A-011		<	2.23	ug/ft2	5A	9094-M-5A-030	Post 1st cleaning - Test 3B		5.27	ug/ft2	G.F. AA
		Average		**2.44**				**Average**		**2.49**		**0**
5C	9094-M-5C-005	Before cleaning		104.00	ug/ft2	5C	9094-M-5C-021	Post 1st cleaning - Test 3A	<	2.32	ug/ft2	
5C	9094-M-5C-006	Before cleaning		293.00	ug/ft2	5C	9094-M-5C-022	Post 1st cleaning - Test 3A	<	2.32	ug/ft2	
5C	9094-M-5C-007	Before cleaning		133.00	ug/ft2	5C	9094-M-5C-023	Post 1st cleaning - Test 3A	<	2.32	ug/ft2	
		Average		**176.67**				**Average**		**2.32**		**174**
5D	9094-M-5D-006	Before cleaning		27.10	ug/ft2	5D	9094-M-5D-020	Post 1st cleaning - Test 3B	<	2.32	ug/ft2	
5D	9094-M-5D-007	Before cleaning		49.10	ug/ft2	5D	9094-M-5D-021	Post 1st cleaning - Test 3B	<	2.32	ug/ft2	
		Average		**38.10**				**Average**		**2.32**		**36**

Table 11.1
Asbestos Wipe Samples - Before Cleaning and Post 1st Cleaning Results

Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Difference
2A	9094-W-2A-001	Before cleaning	<	2,366	S/cm2	2A	9094-W-2A-017	Post 1st cleaning - Test 1B	<	1,183	S/cm2	
2A	9094-W-2A-002	Before cleaning	<	2,366	S/cm2	2A	9094-W-2A-018	Post 1st cleaning - Test 1B	<	1,183	S/cm2	
2A	9094-W-2A-003	Before cleaning		56,192	S/cm2	2A	9094-W-2A-019	Post 1st cleaning - Test 1B		4,397	S/cm2	
2A	9094-W-2A-004	Before cleaning		18,945	S/cm2	2A	9094-W-2A-020	Post 1st cleaning - Test 1B	<	2,366	S/cm2	
2A	9094-W-2A-005	Before cleaning		3,166	S/cm2	2A	9094-W-2A-021	Post 1st cleaning - Test 1B	<	1,183	S/cm2	
		Average		**16,607**				**Average**		**2,063**		**14,544**
2B	9094-W-2B-001	Before cleaning	<	2,366	S/cm2	2B	9094-W-2B-015	Post 1st cleaning - Test 3A	<	5,916	S/cm2	
2B	9094-W-2B-002	Before cleaning	<	2,366	S/cm2	2B	9094-W-2B-016	Post 1st cleaning - Test 3A	<	5,916	S/cm2	
2B	9094-W-2B-003	Before cleaning		102,096	S/cm2	2B	9094-W-2B-017	Post 1st cleaning - Test 3A	<	5,916	S/cm2	
2B	9094-W-2B-004	Before cleaning		5,540	S/cm2	2B	9094-W-2B-018	Post 1st cleaning - Test 3A	<	5,916	S/cm2	
						2B	9094-W-2B-019	Post 1st cleaning - Test 3A		5,936	S/cm2	
		Average		**28,092**				**Average**		**5,920**		**22,172**
3A	9094-W-3A-001	Before cleaning	<	2,366	S/cm2	3A	9094-W-3A-017	Post 1st cleaning - Test 2B		15,037	S/cm2	
3A	9094-W-3A-002	Before cleaning	<	2,366	S/cm2	3A	9094-W-3A-018	Post 1st cleaning - Test 2B	<	11,832	S/cm2	
3A	9094-W-3A-003	Before cleaning	<	2,366	S/cm2	3A	9094-W-3A-019	Post 1st cleaning - Test 2B		3,957	S/cm2	
3A	9094-W-3A-004	Before cleaning		4,749	S/cm2	3A	9094-W-3A-020	Post 1st cleaning - Test 2B		3,166	S/cm2	
						3A	9094-W-3A-021	Post 1st cleaning - Test 2B	<	2,366	S/cm2	
		Average		**2,962**				**Average**		**7,272**		**-4,310**
3B	9094-W-3B-001	Before cleaning	<	2,366	S/cm2	3B	9094-W-3B-018	Post 1st cleaning - Scope A		742	S/cm2	
3B	9094-W-3B-002	Before cleaning	<	2,366	S/cm2	3B	9094-W-3B-019	Post 1st cleaning - Scope A	<	740	S/cm2	
3B	9094-W-3B-003	Before cleaning		3,166	S/cm2	3B	9094-W-3B-020	Post 1st cleaning - Scope A		4,699	S/cm2	
3B	9094-W-3B-004	Before cleaning	<	2,366	S/cm2	3B	9094-W-3B-021	Post 1st cleaning - Scope A		3,957	S/cm2	
						3B	9094-W-3B-022	Post 1st cleaning - Scope A		2,473	S/cm2	
		Average		**2,566**				**Average**		**2,522**		**44**
				.								
3C	9094-W-3C-001	Before cleaning	<	2,366	S/cm2	3C	9094-W-3C-016	Post 1st cleaning - Test 1A	<	2,366	S/cm2	
3C	9094-W-3C-002	Before cleaning		2,374	S/cm2	3C	9094-W-3C-017	Post 1st cleaning - Test 1A		12,663	S/cm2	
3C	9094-W-3C-003	Before cleaning		55,401	S/cm2	3C	9094-W-3C-018	Post 1st cleaning - Test 1A		77,561	S/cm2	
3C	9094-W-3C-004	Before cleaning		75,979	S/cm2	3C	9094-W-3C-019	Post 1st cleaning - Test 1A	<	2,366	S/cm2	
						3C	9094-W-3C-020	Post 1st cleaning - Test 1A		13,454	S/cm2	
		Average		**34,030**				**Average**		**21,682**		**12,348**
3D	9094-W-3D-001	Before cleaning		4,749	S/cm2	3D	9094-W-3D-015	Post 1st cleaning - Test 1A		14,246	S/cm2	
3D	9094-W-3D-002	Before cleaning	<	2,366	S/cm2	3D	9094-W-3D-016	Post 1st cleaning - Test 1A		3,957	S/cm2	
3D	9094-W-3D-003	Before cleaning		172,534	S/cm2	3D	9094-W-3D-017	Post 1st cleaning - Test 1A		10,289	S/cm2	
3D	9094-W-3D-004	Before cleaning		118,716	S/cm2	3D	9094-W-3D-018	Post 1st cleaning - Test 1A		10,289	S/cm2	
3D	9094-W-3D-005	Before cleaning		4,749	S/cm2	3D	9094-W-3D-019	Post 1st cleaning - Test 1A		10,289	S/cm2	
		Average		**60,623**				**Average**		**9,814**		**50,809**
4A	9094-W-4A-001	Before cleaning	<	2,366	S/cm2	4A	9094-W-4A-015	Post 1st cleaning - Test 2A		1,979	S/cm2	
4A	9094-W-4A-002	Before cleaning	<	2,366	S/cm2	4A	9094-W-4A-016	Post 1st cleaning - Test 2A		1,583	S/cm2	
4A	9094-W-4A-003	Before cleaning		2,374	S/cm2	4A	9094-W-4A-017	Post 1st cleaning - Test 2A	<	1,183	S/cm2	
4A	9094-W-4A-004	Before cleaning	<	2,366	S/cm2	4A	9094-W-4A-018	Post 1st cleaning - Test 2A		6,331	S/cm2	
						4A	9094-W-4A-019	Post 1st cleaning - Test 2A	<	1,183	S/cm2	
		Average		**2,368**				**Average**		**2,452**		**-83**

Table 11.1
Asbestos Wipe Samples - Before Cleaning and Post 1st Cleaning Results

Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Difference
4B	9094-W-4B-001	Before cleaning	<	2,366	S/cm2	4B	9094-W-4B-013	Post 1st cleaning - Test 2B	<	2,366	S/cm2	
4B	9094-W-4B-002	Before cleaning	<	2,366	S/cm2	4B	9094-W-4B-014	Post 1st cleaning - Test 2B	<	2,366	S/cm2	
4B	9094-W-4B-003	Before cleaning		18,203	S/cm2	4B	9094-W-4B-015	Post 1st cleaning - Test 2B		4,749	S/cm2	
4B	9094-W-4B-004	Before cleaning		13,454	S/cm2	4B	9094-W-4B-016	Post 1st cleaning - Test 2B	<	2,366	S/cm2	
4B	9094-W-4B-005	Before cleaning		3,166	S/cm2	4B	9094-W-4B-017	Post 1st cleaning - Test 2B	<	2,366	S/cm2	
		Average		**7,911**				**Average**		**2,843**		**5,068**
4C	9094-W-4C-001	Before cleaning	<	2,366	S/cm2	4C	9094-W-4C-018	Post 1st cleaning - Test 1A	<	2,366	S/cm2	
4C	9094-W-4C-002	Before cleaning	<	2,366	S/cm2	4C	9094-W-4C-019	Post 1st cleaning - Test 1A	<	2,366	S/cm2	
4C	9094-W-4C-003	Before cleaning		49,069	S/cm2	4C	9094-W-4C-020	Post 1st cleaning - Test 1A		3,166	S/cm2	
4C	9094-W-4C-004	Before cleaning		3,166	S/cm2	4C	9094-W-4C-021	Post 1st cleaning - Test 1A	<	2,366	S/cm2	
						4C	9094-W-4C-022	Post 1st cleaning - Test 1A	<	2,366	S/cm2	
		Average		**14,242**				**Average**		**2,526**		**11,716**
4D	9094-W-4D-001	Before cleaning	<	2,366	S/cm2	4D	9094-W-4D-019	Post 1st cleaning - Test 2A		2,374	S/cm2	
4D	9094-W-4D-002	Before cleaning	<	2,366	S/cm2	4D	9094-W-4D-020	Post 1st cleaning - Test 2A	<	2,366	S/cm2	
4D	9094-W-4D-003	Before cleaning		34,032	S/cm2	4D	9094-W-4D-021	Post 1st cleaning - Test 2A		26,118	S/cm2	
4D	9094-W-4D-004	Before cleaning		2,374	S/cm2	4D	9094-W-4D-022	Post 1st cleaning - Test 2A		43,529	S/cm2	
4D	9094-W-4D-005	Before cleaning		3,166	S/cm2	4D	9094-W-4D-023	Post 1st cleaning - Test 2A		18,995	S/cm2	
		Average		**8,861**				**Average**		**18,676**		**-9,815**
5A	9094-W-5A-001	Before cleaning	<	2,366	S/cm2	5A	9094-W-5A-019	Post 1st cleaning - Test 3B	<	2,366	S/cm2	
5A	9094-W-5A-002	Before cleaning	<	2,366	S/cm2	5A	9094-W-5A-020	Post 1st cleaning - Test 3B	<	2,366	S/cm2	
5A	9094-W-5A-003	Before cleaning		233,475	S/cm2	5A	9094-W-5A-021	Post 1st cleaning - Test 3B	<	2,366	S/cm2	
5A	9094-W-5A-004	Before cleaning		22,952	S/cm2	5A	9094-W-5A-022	Post 1st cleaning - Test 3B	<	2,366	S/cm2	
						5A	9094-W-5A-023	Post 1st cleaning - Test 3B	<	2,366	S/cm2	
		Average		**65,290**				**Average**		**2,366**		**62,923**
5C	9094-W-5C-001	Before cleaning		9,497	S/cm2	5C	9094-W-5C-016	Post 1st cleaning - Test 3A		2,374	S/cm2	
5C	9094-W-5C-002	Before cleaning		3,166	S/cm2	5C	9094-W-5C-017	Post 1st cleaning - Test 3A	<	2,366	S/cm2	
5C	9094-W-5C-003	Before cleaning		97,347	S/cm2	5C	9094-W-5C-018	Post 1st cleaning - Test 3A	<	2,366	S/cm2	
5C	9094-W-5C-004	Before cleaning		30,075	S/cm2	5C	9094-W-5C-019	Post 1st cleaning - Test 3A		3,166	S/cm2	
						5C	9094-W-5C-020	Post 1st cleaning - Test 3A		3,166	S/cm2	
		Average		**35,021**				**Average**		**2,688**		**32,333**
5D	9094-W-5D-001	Before cleaning	<	2,366	S/cm2	5D	9094-W-5D-015	Post 1st cleaning - Test 3B	<	5,916	S/cm2	
5D	9094-W-5D-002	Before cleaning	<	2,366	S/cm2	5D	9094-W-5D-016	Post 1st cleaning - Test 3B	<	5,916	S/cm2	
5D	9094-W-5D-003	Before cleaning	<	2,366	S/cm2	5D	9094-W-5D-017	Post 1st cleaning - Test 3B	<	5,916	S/cm2	
5D	9094-W-5D-004	Before cleaning		4,749	S/cm2	5D	9094-W-5D-018	Post 1st cleaning - Test 3B	<	5,916	S/cm2	
5D	9094-W-5D-005	Before cleaning		36,406	S/cm2	5D	9094-W-5D-019	Post 1st cleaning - Test 3B	<	5,916	S/cm2	
		Average		**9,651**				**Average**		**5,916**		**3,735**

Table 11.1
MMVF Wipe Samples - Before Cleaning and Post 1st Cleaning Results

Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Difference
2A	9094-W-2A-002	Before cleaning	<	57.23	mmvf_S/c	2A	9094-W-2A-017	Post 1st cleaning - Test 1B		57.23	mmvf_S/c	
2A	9094-W-2A-003	Before cleaning		629.55	mmvf_S/c	2A	9094-W-2A-018	Post 1st cleaning - Test 1B		114.46	mmvf_S/c	
2A	9094-W-2A-004	Before cleaning		2117.56	mmvf_S/c	2A	9094-W-2A-019	Post 1st cleaning - Test 1B		171.69	mmvf_S/c	
2A	9094-W-2A-005	Before cleaning		343.39	mmvf_S/c	2A	9094-W-2A-020	Post 1st cleaning - Test 1B		57.23	mmvf_S/c	
						2A	9094-W-2A-021	Post 1st cleaning - Test 1B		114.46	mmvf_S/c	
		Average		**786.93**				**Average**		**103.01**		**684**
2B	9094-W-2B-002	Before cleaning		629.55	mmvf_S/c	2B	9094-W-2B-015	Post 1st cleaning - Test 3A	<	57.23	mmvf_S/c	
2B	9094-W-2B-003	Before cleaning		13163.22	mmvf_S/c	2B	9094-W-2B-016	Post 1st cleaning - Test 3A		114.46	mmvf_S/c	
2B	9094-W-2B-004	Before cleaning		400.62	mmvf_S/c	2B	9094-W-2B-017	Post 1st cleaning - Test 3A		228.93	mmvf_S/c	
						2B	9094-W-2B-018	Post 1st cleaning - Test 3A		171.69	mmvf_S/c	
						2B	9094-W-2B-019	Post 1st cleaning - Test 3A		171.69	mmvf_S/c	
		Average		**4731.13**				**Average**		**148.80**		**4,582**
3A	9094-W-3A-002	Before cleaning		57.23	mmvf_S/c	3A	9094-W-3A-017	Post 1st cleaning - Test 2B	<	22.89	mmvf_S/c	
3A	9094-W-3A-003	Before cleaning		801.24	mmvf_S/c	3A	9094-W-3A-018	Post 1st cleaning - Test 2B	<	22.89	mmvf_S/c	
3A	9094-W-3A-004	Before cleaning		686.78	mmvf_S/c	3A	9094-W-3A-019	Post 1st cleaning - Test 2B	<	22.89	mmvf_S/c	
						3A	9094-W-3A-020	Post 1st cleaning - Test 2B	<	22.89	mmvf_S/c	
						3A	9094-W-3A-021	Post 1st cleaning - Test 2B	<	22.89	mmvf_S/c	
		Average		**515.08**				**Average**		**22.89**		**492**
3B	9094-W-3B-002	Before cleaning		744.01	mmvf_S/c	3B	9094-W-3B-018	Post 1st cleaning - Scope A		57.23	mmvf_S/c	
3B	9094-W-3B-003	Before cleaning		2289.26	mmvf_S/c	3B	9094-W-3B-019	Post 1st cleaning - Scope A	<	57.23	mmvf_S/c	
3B	9094-W-3B-004	Before cleaning		744.01	mmvf_S/c	3B	9094-W-3B-020	Post 1st cleaning - Scope A	<	57.23	mmvf_S/c	
						3B	9094-W-3B-021	Post 1st cleaning - Scope A		57.23	mmvf_S/c	
						3B	9094-W-3B-022	Post 1st cleaning - Scope A	<	57.23	mmvf_S/c	
		Average		**1259.09**				**Average**		**57.23**		**1,202**
				.								
3C	9094-W-3C-002	Before cleaning		343.39	mmvf_S/c	3C	9094-W-3C-016	Post 1st cleaning - Test 1A		57.23	mmvf_S/c	
3C	9094-W-3C-003	Before cleaning		744.01	mmvf_S/c	3C	9094-W-3C-017	Post 1st cleaning - Test 1A		171.69	mmvf_S/c	
3C	9094-W-3C-004	Before cleaning		343.39	mmvf_S/c	3C	9094-W-3C-018	Post 1st cleaning - Test 1A		400.62	mmvf_S/c	
						3C	9094-W-3C-019	Post 1st cleaning - Test 1A		114.46	mmvf_S/c	
						3C	9094-W-3C-020	Post 1st cleaning - Test 1A		114.46	mmvf_S/c	
		Average		**476.93**				**Average**		**171.69**		**305**
3D	9094-W-3D-002	Before cleaning		228.93	mmvf_S/c	3D	9094-W-3D-015	Post 1st cleaning - Test 1A	<	22.89	mmvf_S/c	
3D	9094-W-3D-003	Before cleaning		572.31	mmvf_S/c	3D	9094-W-3D-016	Post 1st cleaning - Test 1A		22.89	mmvf_S/c	
3D	9094-W-3D-004	Before cleaning		1259.09	mmvf_S/c	3D	9094-W-3D-017	Post 1st cleaning - Test 1A	<	22.89	mmvf_S/c	
3D	9094-W-3D-005	Before cleaning		343.39	mmvf_S/c	3D	9094-W-3D-018	Post 1st cleaning - Test 1A	<	22.89	mmvf_S/c	
						3D	9094-W-3D-019	Post 1st cleaning - Test 1A	<	22.89	mmvf_S/c	
		Average		**600.93**				**Average**		**22.89**		**578**
4A	9094-W-4A-002	Before cleaning		400.62	mmvf_S/c	4A	9094-W-4A-015	Post 1st cleaning - Test 2A	<	22.89	mmvf_S/c	
4A	9094-W-4A-003	Before cleaning		629.55	mmvf_S/c	4A	9094-W-4A-016	Post 1st cleaning - Test 2A	<	22.89	mmvf_S/c	
4A	9094-W-4A-004	Before cleaning		171.69	mmvf_S/c	4A	9094-W-4A-017	Post 1st cleaning - Test 2A		22.89	mmvf_S/c	
4A						4A	9094-W-4A-018	Post 1st cleaning - Test 2A	<	22.89	mmvf_S/c	
						4A	9094-W-4A-019	Post 1st cleaning - Test 2A	<	22.89	mmvf_S/c	
		Average		**400.62**				**Average**		**22.89**		**378**

Table 11.1
MMVF Wipe Samples - Before Cleaning and Post 1st Cleaning Results

Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Unit Number	Sample_Id	Cleaning Type	Sign	Result	Units	Difference
4B	9094-W-4B-002	Before cleaning		286.16	mmvf_S/c	4B	9094-W-4B-013	Post 1st cleaning - Test 2B		286.16	mmvf_S/c	
4B	9094-W-4B-003	Before cleaning		629.55	mmvf_S/c	4B	9094-W-4B-014	Post 1st cleaning - Test 2B		228.93	mmvf_S/c	
4B	9094-W-4B-004	Before cleaning		400.62	mmvf_S/c	4B	9094-W-4B-015	Post 1st cleaning - Test 2B		400.62	mmvf_S/c	
4B	9094-W-4B-005	Before cleaning		686.78	mmvf_S/c	4B	9094-W-4B-016	Post 1st cleaning - Test 2B		171.69	mmvf_S/c	
						4B	9094-W-4B-017	Post 1st cleaning - Test 2B		57.23	mmvf_S/c	
		Average		**500.78**				**Average**		**228.93**		**272**
4C	9094-W-4C-002	Before cleaning		57.23	mmvf_S/c	4C	9094-W-4C-018	Post 1st cleaning - Test 1A		57.23	mmvf_S/c	
4C	9094-W-4C-003	Before cleaning		1030.17	mmvf_S/c	4C	9094-W-4C-019	Post 1st cleaning - Test 1A		228.93	mmvf_S/c	
4C	9094-W-4C-004	Before cleaning		343.39	mmvf_S/c	4C	9094-W-4C-020	Post 1st cleaning - Test 1A		343.39	mmvf_S/c	
						4C	9094-W-4C-021	Post 1st cleaning - Test 1A		114.46	mmvf_S/c	
						4C	9094-W-4C-022	Post 1st cleaning - Test 1A		228.93	mmvf_S/c	
		Average		**476.93**				**Average**		**194.59**		**282**
4D	9094-W-4D-002	Before cleaning		400.62	mmvf_S/c	4D	9094-W-4D-019	Post 1st cleaning - Test 2A		57.23	mmvf_S/c	
4D	9094-W-4D-003	Before cleaning		2174.79	mmvf_S/c	4D	9094-W-4D-020	Post 1st cleaning - Test 2A		171.69	mmvf_S/c	
4D	9094-W-4D-004	Before cleaning		286.16	mmvf_S/c	4D	9094-W-4D-021	Post 1st cleaning - Test 2A		572.31	mmvf_S/c	
4D	9094-W-4D-005	Before cleaning		457.85	mmvf_S/c	4D	9094-W-4D-022	Post 1st cleaning - Test 2A		228.93	mmvf_S/c	
						4D	9094-W-4D-023	Post 1st cleaning - Test 2A		228.93	mmvf_S/c	
		Average		**829.86**				**Average**		**251.82**		**578**
5A	9094-W-5A-002	Before cleaning		297.60	mmvf_S/c	5A	9094-W-5A-019	Post 1st cleaning - Test 3B		286.16	mmvf_S/c	
5A	9094-W-5A-003	Before cleaning		1308.15	mmvf_S/c	5A	9094-W-5A-020	Post 1st cleaning - Test 3B		57.23	mmvf_S/c	
5A	9094-W-5A-004	Before cleaning		792.45	mmvf_S/c	5A	9094-W-5A-021	Post 1st cleaning - Test 3B		114.46	mmvf_S/c	
						5A	9094-W-5A-022	Post 1st cleaning - Test 3B		57.23	mmvf_S/c	
						5A	9094-W-5A-023	Post 1st cleaning - Test 3B		114.46	mmvf_S/c	
		Average		**799.40**				**Average**		**125.91**		**673**
5C	9094-W-5C-002	Before cleaning		457.85	mmvf_S/c	5C	9094-W-5C-016	Post 1st cleaning - Test 3A		1774.17	mmvf_S/c	
5C	9094-W-5C-003	Before cleaning		457.85	mmvf_S/c	5C	9094-W-5C-017	Post 1st cleaning - Test 3A		744.01	mmvf_S/c	
5C	9094-W-5C-004	Before cleaning		1144.63	mmvf_S/c	5C	9094-W-5C-018	Post 1st cleaning - Test 3A		4211.37	mmvf_S/c	
						5C	9094-W-5C-019	Post 1st cleaning - Test 3A		2758.14	mmvf_S/c	
						5C	9094-W-5C-020	Post 1st cleaning - Test 3A		1316.32	mmvf_S/c	
		Average		**686.78**				**Average**		**2160.80**		**-1,474**
5D	9094-W-5D-002	Before cleaning		251.82	mmvf_S/c	5D	9094-W-5D-015	Post 1st cleaning - Test 3B		171.69	mmvf_S/c	
5D	9094-W-5D-003	Before cleaning		206.03	mmvf_S/c	5D	9094-W-5D-016	Post 1st cleaning - Test 3B		228.93	mmvf_S/c	
5D	9094-W-5D-004	Before cleaning		712.21	mmvf_S/c	5D	9094-W-5D-017	Post 1st cleaning - Test 3B		171.69	mmvf_S/c	
5D	9094-W-5D-005	Before cleaning		595.21	mmvf_S/c	5D	9094-W-5D-018	Post 1st cleaning - Test 3B		114.46	mmvf_S/c	
						5D	9094-W-5D-019	Post 1st cleaning - Test 3B		228.93	mmvf_S/c	
		Average		**441.32**				**Average**		**183.14**		**258**

Table 11.2

Exceedances of COPC by Cleaning Event

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Second Floor Hallway: Test 4A

	Cleanup Criteria			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m	4 ng/m2				
PAH	0.2 ug/m3	300 ug/m2				
Asbestos	0.0009 f/cc	n/a				
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2			
MMVF	0.01 f/cc	n/a				
Silica	4 ug/m3	n/a				

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 5C: Test 3A, 3B

	Cleanup Criteria			Pre-Cleaning			Post-First Cleaning			Post-Second Cleaning			Post-Third Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2													
PAH	0.2 ug/m3	300 ug/m2			303.5										
Asbestos	0.0009 f/cc	n/a					OL			OL			0.0016		
							OL			OL			0.0015		
							OL			OL					
										OL					
										OL					
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		336	104		SB							
					43.6	293									
						133									
MMVF	0.01 f/cc	n/a					13.399			16.598					
							19.25			12.621					
Silica	4 ug/m3	n/a													

OL = Overloading of particulates
MV = Microvac
SB = Sample broken

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 5A: Test 3B

	Cleanup Criteria			Pre-Cleaning			Post-First Cleaning			Post - Second Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2										
PAH	0.2 ug/m3	300 ug/m2										
Asbestos	0.0009 f/cc	n/a										
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		191			43.5				
					2000			39.7				
MMVF	0.01 f/cc	n/a										
Silica	4 ug/m3	n/a					LT 0.007					

OL = Overloading of particulates
MV = Microvac
LT = Concentration is less than the specified level of detection

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 4D: Test 2A

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning			Post - Second Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2										
PAH	0.2 ug/m3	300 ug/m2			325.8							
Asbestos	0.0009 f/cc	n/a										
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		169	83.5	0.146 R	20.4 R				
						66	0.137 R	66 R				
						26.2		10.6 R				
						39.9		15.6 R				
						78.2						
						72.1						
MMVF	0.01 f/cc	n/a										
Silica	4 ug/m3	n/a										

MV = Microvac
R = Result rejected

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 4C: Test 1A

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning			Post - Second Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2										
PAH	0.2 ug/m3	300 ug/m2										
Asbestos	0.0009 f/cc	n/a										
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		181	76.1		NOT ANALYZED				
					77.5	83.7		14.9 R				
						69.8		8.28 R				
						70.8		7.81 R				
MMVF	0.01 f/cc	n/a										
Silica	4 ug/m3	n/a										

MV = Microvac
R = Result rejected

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 4B: Test 2B

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning			Post - Second Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2										
PAH	0.2 ug/m3	300 ug/m2										
Asbestos	0.0009 f/cc	n/a										
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		50							
					30							
MMVF	0.01 f/cc	n/a										
Silica	4 ug/m3	n/a										

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 4A: Test 2A

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning			Post - Second Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2										
PAH	0.2 ug/m3	300 ug/m2										
Asbestos	0.0009 f/cc	n/a					OL					
							OL					
							OL					
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2									
MMVF	0.01 f/cc	n/a										
Silica	4 ug/m3	n/a					0.008					

OL = Overloading of particulates
MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 3D: Test 1A

	Cleanup Criteria			Pre-Cleaning			Post-First Cleaning			Post-Second Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2										
PAH	0.2 ug/m3	300 ug/m2										
Asbestos	0.0009 f/cc	n/a					OL					
							OL					
							OL					
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		201	50.7	0.074 R		5.71 R			
					112		0.126 R					
MMVF	0.01 f/cc	n/a										
Silica	4 ug/m3	n/a										

OL = Overloading of particulates
MV = Microvac
R = Result rejected

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 3C: Test 1A, 3B

	Cleanup Criteria			Pre-Cleaning			Post-First Cleaning			Post-Second Cleaning			Post-Third Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2			6.2										
PAH	0.2 ug/m3	300 ug/m2			1046.6										
Asbestos	0.0009 f/cc	n/a					OL			OL					
							OL			OL					
							OL			OL					
										OL					
										OL					
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		750	68.4			26.9						
					48.7	135									
						43.3									
						39.4									
MMVF	0.01 f/cc	n/a								91.796					
Silica	4 ug/m3	n/a													

OL = Overloading of particulates
MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 3B: Scope A

	Cleanup Criteria			Pre-Cleaning			Post-First Cleaning			Post-Second Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2										
PAH	0.2 ug/m3	300 ug/m2										
Asbestos	0.0009 f/cc	n/a					OL					
							OL					
							OL					
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		SAMPLE LOST			51.6			SB	
MMVF	0.01 f/cc	n/a		14.78								
Silica	4 ug/m3	n/a										

OL = Overloading of particulates
MV = Microvac
SB = Sample broken

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 3, Unit 3A: Test 2B

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2							
PAH	0.2 ug/m3	300 ug/m2							
Asbestos	0.0009 f/cc	n/a					OL		
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		38.9		0.116 R		
							0.131 R		
MMVF	0.01 f/cc	n/a							
Silica	4 ug/m3	n/a							

OL = Overloading of particulates
MV = Microvac
R = Result rejected

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 2B: Test 3A

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning			Post - Second Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2										
PAH	0.2 ug/m3	300 ug/m2										
Asbestos	0.0009 f/cc	n/a										
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		97							
MMVF	0.01 f/cc	n/a										
Silica	4 ug/m3	n/a										

UD = Uneven distribution of material
OL = Overloading of particulates
MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event
Unit 2A: Test 1B

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning			Post - Second Cleaning			Post - Third Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2													
PAH	0.2 ug/m3	300 ug/m2													
Asbestos	0.0009 f/cc	n/a					OL								
							OL								
							OL								
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		49.4										
					44.6										
					35.4										
MMVF	0.01 f/cc	n/a													
Silica	4 ug/m3	n/a													

OL = Overloading of particulates
MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Mattress Store: Test A (Industrial HEPA filtered vacuums, AFD)

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2							
PAH	0.2 ug/m3	300 ug/m2		LT 2.7					
Asbestos	0.0009 f/cc	n/a		OL			OL		
				OL			OL		
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		38.9			43.9	
					77			42.2	
MMVF	0.01 f/cc	n/a		11.716					
				92.184					
Silica	4 ug/m3	n/a							

OL = Overloading of particulates
MV = Microvac
LT = Concentration is less than the specified level of detection

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event
Mattress Store: Test B (Wet wipe all walls)

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2							
PAH	0.2 ug/m3	300 ug/m2		2.7					
Asbestos	0.0009 f/cc	n/a		OL			OL		
				OL			OL		
							OL		
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		38.9			91.5	
					77			79.3	
MMVF	0.01 f/cc	n/a		11.716					
				92.184					
Silica	4 ug/m3	n/a							

OL = Overloading of particulates
MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Mattress Store: Test C (Hot water carpet shampoo)

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2							
PAH	0.2 ug/m3	300 ug/m2		2.7					
Asbestos	0.0009 f/cc	n/a		OL			0.0025		
				OL			0.0016		
							0.0025		
							0.0016		
							0.0016		
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		38.9				
					77				
MMVF	0.01 f/cc	n/a		11.716					
				92.184					
Silica	4 ug/m3	n/a							

OL = Overloading of particulates
MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Mattress Store: Test D (A/C duct cleaning)

			Pre-Cleaning			Post - First Cleaning		
COPC	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	4 ng/m2							
PAH	300 ug/m2		2.7					
Asbestos	n/a		OL					
			OL					
Lead	25 ug/ft2	25 ug/ft2		38.9				
				77				
MMVF	n/a		11.716					
			92.184					
Silica	n/a							

OL = Overloading of particulates
MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Mattress Store: Test E

(Cleaning of vinyl floor tile and window ledge wet wipe using water only)

	Cleanup Criteria			Pre-Cleaning			Pre-Water	Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Wipe**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2								
PAH	0.2 ug/m3	300 ug/m2		2.7						
Asbestos	0.0009 f/cc	n/a		OL						
				OL						
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		38.9				38.2	
					77					
MMVF	0.01 f/cc	n/a		11.716						
				92.184						
Silica	4 ug/m3	n/a								

OL = Overloading of particulates
MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Liberty Street Staircase: Test 4A, 4B

	Cleanup Criteria			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2				
PAH	0.2 ug/m3	300 ug/m2				
Asbestos	0.0009 f/cc	n/a				
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2			
MMVF	0.01 f/cc	n/a				
Silica	4 ug/m3	n/a		22		

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Lemongrass Grill: Test 4A

	Cleanup Criteria			Pre-Cleaning			Post-First Cleaning			Post-Second Cleaning			Post-Encap.		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2													
PAH	0.2 ug/m3	300 ug/m2													
Asbestos	0.0009 f/cc	n/a					OL								
							OL								
							OL								
							OL								
							OL								
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		10700 J			25.9 R							
								166							
MMVF	0.01 f/cc	n/a													
Silica	4 ug/m3	n/a													

OL = Overloading of particulates
MV = Microvac
R = Result rejected
J = Estimated concentration

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Lemongrass Grill Basement

	Cleanup Criteria			Post-First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2				
PAH	0.2 ug/m3	300 ug/m2				
Asbestos	0.0009 f/cc	n/a				
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2			
MMVF	0.01 f/cc	n/a				
Silica	4 ug/m3	n/a				

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

The Food Exchange: Test 4A

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning			Post-Encap.		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2										
PAH	0.2 ug/m3	300 ug/m2										
Asbestos	0.0009 f/cc	n/a										
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		1310			136				
								183				
MMVF	0.01 f/cc	n/a										
Silica	4 ug/m3	n/a										

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

The Food Exchange Basement

	Cleanup Criteria			Post-First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/	4 ng/m2				
PAH	0.2 ug/m3	300 ug/m2				
Asbestos	0.0009 f/c	n/a				
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2			
MMVF	0.01 f/cc	n/a				
Silica	4 ug/m3	n/a				

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Elevator Shaft/Compactor Room: Test 4A

	Cleanup Criteria			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2				
PAH	0.2 ug/m3	300 ug/m2				
Asbestos	0.0009 f/cc	n/a				
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2			
MMVF	0.01 f/cc	n/a				
Silica	4 ug/m3	n/a				

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Chiropractor's Office: Test A (Industrial HEPA filtered vacuums, AFD)

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2							
PAH	0.2 ug/m3	300 ug/m2							
Asbestos	0.0009 f/cc	n/a					UD		
							OL		
							OL		
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		433	28.2		146	
					346	181 J		64.5	
					116	69.3 J			
					74.7				
MMVF	0.01 f/cc	n/a							
Silica	4 ug/m3	n/a					LT 8		

UD = Uneven distribution of material
OL = Overloading of particulates
MV = Microvac
J = Estimated concentration
LT = Concentration is less than the specified level of detection

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Chiropractor's Office: Test B (Wet Wipe all walls)

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2							
PAH	0.2 ug/m3	300 ug/m2							
Asbestos	0.0009 f/cc	n/a					OL		
							0.039		
							OL		
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		433	28.2		147	
					346	181		556	
					116	69.3			
					74.7				
MMVF	0.01 f/cc	n/a					17.579		
							60.606		
Silica	4 ug/m3	n/a							

OL = Overloading of particulates
M.V. = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Chiropractor's Office: Test C (Hot water wet vacuum)

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2							
PAH	0.2 ug/m3	300 ug/m2							
Asbestos	0.0009 f/cc	n/a					OL		
							0.0033		
							OL		
							OL		
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		433	28.2	1.89		
					346	181	2.56		
					116	69.3			
					74.7				
MMVF	0.01 f/cc	n/a							
Silica	4 ug/m3	n/a							

OL = Overloading of particulates
MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Chiropractor's Office: Test D (A/C duct cleaning)

	Cleanup Criteria			Pre-Cleaning			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2							
PAH	0.2 ug/m3	300 ug/m2							
Asbestos	0.0009 f/cc	n/a							
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		433	28.2			
					346	181			
					116	69.3			
					74.7				
MMVF	0.01 f/cc	n/a							
Silica	4 ug/m3	n/a							

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Chiropractor's Office: Test E

(Cleaning of bathroom floor and desk top wet wipe using water only)

	Cleanup Criteria			Pre-Cleaning			Pre-Water	Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Wipe**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2								
PAH	0.2 ug/m3	300 ug/m2								
Asbestos	0.0009 f/cc	n/a								
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		433	28.2	147 ug/ft2 (Tile)		954 (Tile)	
					346	181	556 ug/ft2 (Desk)			
					116	69.3				
					74.7					
MMVF	0.01 f/cc	n/a								
Silica	4 ug/m3	n/a								

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Cedar Street Staircase: Test 4A, 4B

	Cleanup Criteria			Post - First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2				
PAH	0.2 ug/m3	300 ug/m2				
Asbestos	0.0009 f/cc	n/a				
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2			
MMVF	0.01 f/cc	n/a				
Silica	4 ug/m3	n/a				

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Barber Shop: Test 4A, 4E

	Cleanup Criteria			Pre-Water Wipe		Post-Water Wipe	
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**Air**	**Wipe**
Dioxin	0.001 ng/m3	4 ng/m2					
PAH	0.2 ug/m3	300 ug/m2					
Asbestos	0.0009 f/cc	n/a					
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		12.1 R		
					25.9 R		
					42.9		
MMVF	0.01 f/cc	n/a					
Silica	4 ug/m3	n/a					

MV = Microvac
R = Result rejected

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Fifth Floor Hallway: Test 4A

	Cleanup Criteria			Post-First Cleaning			Post-Second Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m	4 ng/m2							
PAH	0.2 ug/m3	300 ug/m2							
Asbestos	0.0009 f/cc	n/a		OL					
				OL					
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2						
MMVF	0.01 f/cc	n/a							
Silica	4 ug/m3	n/a							

OL = Overloading of particulates
MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Fourth Floor Hallway: Test 4A

	Cleanup Criteria			Post-Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2				
PAH	0.2 ug/m3	300 ug/m2				
Asbestos	0.0009 f/cc	n/a				
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2			
MMVF	0.01 f/cc	n/a				
Silica	4 ug/m3	n/a				

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Third Floor Hallway: Test 4A

	Cleanup Criteria			Post - FirstCleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m3	4 ng/m2				
PAH	0.2 ug/m3	300 ug/m2				
Asbestos	0.0009 f/cc	n/a				
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2			
MMVF	0.01 f/cc	n/a				
Silica	4 ug/m3	n/a				

MV = Microvac

Table 11.2

Contaminants of Potential Concern (COPC) Exceedance By Event

Unit 5D: Test 3B

	Cleanup Criteria			Pre-Cleaning			Post-First Cleaning		
COPC	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**	**Air**	**Wipe**	**MV**
Dioxin	0.001 ng/m	4 ng/m2							
PAH	0.2 ug/m3	300 ug/m2							
Asbestos	0.0009 f/cc	n/a							
Lead	1 ug/m3	25 ug/ft2	25 ug/ft2		25.3	27.1			
					32.1	49.1			
MMVF	0.01 f/cc	n/a							
Silica	4 ug/m3	n/a							

MV = Microvac